बुलेटिन
नेपाल भौगर्भिक समाज

Volume 25 **April 2008 (बैशाख २०६५)**

BULLETIN
OF
NEPAL GEOLOGICAL SOCIETY

NEPAL GEOLOGICAL SOCIETY
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Editorial

The Nepal Geological Society, Editorial Board is very much pleased to publish this *Volume 25 of Bulletin* as its regular publication. This *Bulletin, Volume 25* as in other regular volumes also contains the news about the activities of the Society during the preceding year, number of scientific articles on topics of interest, abstracts or information on papers presented during the ISDR Day-2007 or Scientific Talk Programs and other information which we thought may be of interest to the geo-scientific community and to all others interested in geo-science.

The Editorial Board would like to extend its sincere appreciation and express thanks to all the authors for contributing their papers to this issue of the Bulletin. Similarly, the Editorial Board would like to extend sincere thanks to all the members of the Society who had helped us in bringing out this volume. On behalf of the Society, the Editorial Board would also like to acknowledge the consulting firms, agencies and organizations for their technical and financial support to the Society.

The Editorial Board hopes that this volume will also fulfill the intended purpose behind the motto of publishing the Bulletin of the Nepal Geological Society. We appreciate very much comments and suggestions from the members of the Society and other readers in enhancing the Bulletin and hope to receive continued support and co-operation in its publication work in future also.

Thank you! **– Editors**

NEPAL GEOLOGICAL SOCIETY

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September 2007 – August 2010

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LIST OF PUBLISHED JOURNAL OF NEPAL GEOLOGICAL SOCIETY

1. Journal of Nepal Geological Society (Abstracts of Fifth Nepal Geological Congress on Geology, Environment, and Natural Hazards Mitigation: Key to National Development, 26–27 November 2007), Vol. 36 (Special Issue), Novmember 2007
2. Journal of Nepal Geological Society, Vol. 35, June 2007
3. Journal of Nepal Geological Society (Proceedings of Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation, 28–30 September 2005), Vol. 34 (Special Issue),
4. Journal of Nepal Geological Society, Vol. 33, June 2006
5. Journal of Nepal Geological Society (Abstracts of Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation, 28–30 September 2005), Vol. 32 (Special Issue), September 2005
6. Journal of Nepal Geological Society, Vol. 31, June 2005
7. Journal of Nepal Geological Society (Proceedings of Fourth Nepal Geological Congress, 9–11 April 2004), Vol. 30 (Special Issue), December 2004
8. Journal of Nepal Geological Society, Vol. 29, June 2004
9. Journal of Nepal Geological Society, Vol. 28, June 2003
10. Journal of Nepal Geological Society (Proceedings of Third Nepal Geological Congress, 26–28 September 2001, Kathmandu, Nepal), Vol. 27 (Special Issue), September 2002
11. Journal of Nepal Geological Society, Vol. 26, June 2002
12. Journal of Nepal Geological Society (Proceedings of Workshop on the Himalayan Uplift and Palaeoclimatic Changes in Central Nepal, 10 November 2000), Vol. 25 (Special Issue), December 2001
13. Journal of Nepal Geological Society (Abstract Volume of Third Nepal Geological Congress, 26–28 September 2001), Vol. 24 (Special Issue), September 2001,
14. Journal of Nepal Geological Society, Vol. 23, June 2001
15. Journal of Nepal Geological Society (Proceedings of International Symposium on Engineering Geology, Hydrogeology, and Natural Disaster with Emphasis on Asia, 28–30 September 1999, Kathmandu, Nepal), Vol. 22 (Special Issue), December 2000,
16. Journal of Nepal Geological Society, Vol. 21, June 2000
17. Journal of Nepal Geological Society (Abstract Volume of International Symposium on Engineering Geology, Hydrogeology, and Natural Disaster with Emphasis on Asia, 28–30 September 1999, Kathmandu, Nepal), Vol. 20 (Special Issue), 1999
18. Journal of Nepal Geological Society, Vol. 19, 1999
19. Journal of Nepal Geological Society (Proceedings of Second Nepal Geological Congress, 1995), Vol. 18 (Special Issue), 1998
20. Journal of Nepal Geological Society, Vol. 17, 1997
21. Journal of Nepal Geological Society, (Abstract Volume of Second Nepal Geological Congress), Vol. 16 (Special Issue), 1997
22. Journal of Nepal Geological Society, Vol. 15, 1997
23. Journal of Nepal Geological Society, (Proceedings of First Nepal Geological Congress, 1995), Vol. 14 (Special Issue), 1996,
24. Journal of Nepal Geological Society, Vol. 13, 1996
25. Journal of Nepal Geological Society (Abstract Volume of First Nepal Geological Congress, 1995), Vol. 12 (Special Issue), 1995
26. Journal of Nepal Geological Society (Proceedings of 9th Himalaya–Karakoram–Tibet Workshop, 1994), Vol. 11 (Special Issue), 1995
27. Journal of Nepal Geological Society, Vol. 10, 1995

28. Journal of Nepal Geological Society (Abstracts of 9th Himalaya– Karakoram–Tibet Workshop, 1994), Vol. 10 (Special Issue), 1994 29
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34. Journal of Nepal Geological Society, Vol. 5, No. 1, 198835.
35. Journal of Nepal Geological Society, Vol. 4 No. 1 & 2, 1987
36. Journal of Nepal Geological Society, Vol. 4 (Special Issue), 1984*
37. Journal of Nepal Geological Society, Vol. 3, No 1 & 2, 1985
38. Journal of Nepal Geological Society, Vol. 2 No. 2, 1985
39. Journal of Nepal Geological Society, Vol. 2 (Special Issue), 1982*
40. Journal of Nepal Geological Society, Vol. 2, No. 1, 1981
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NGS News

The **28th Annual General Body Meeting** of the Nepal Geological Society (NGS) was held in the auditorium hall of the United World Trade Center, Tripureshwor, Kathmandu on 31st August 2007 (B.S. 2064 Bhadra 14). President of the 12th Executive Committee Dr. Ramesh Man Tuladhar chaired the meeting. The meeting began with the welcome speech by Dr. Ramesh Man Tuladhar. General Secretary Mr. Lila Nath Rimal presented the Annual Report to the General Body highlighting the various activities and events which happened during the period of 12th Executive Committee. Then, Mr. Jaya Raj Ghimire, Treasurer presented the Financial Report including the Auditor's Report for the Fiscal Year 2063/064 B.S. President-elect Dr. Megh Raj Dhital also addressed the General Body and spoke briefly about the plan and program and the direction the newly elected Executive Committee will take to lead the Society in the coming days. At the end, Dr. Tuladhar concluded the General Body Meeting.

Office Handover and Installation of the 13th Executive Committee Ceremony was held in the evening in the same venue. Vice-Chancellor of Tribhuvan University Prof. Dr. Madhav Prasad Sharma was the Chief Guest of the evening ceremony program. The evening program was chaired by Director General of the Department of Mines and Geology Mr. Pranab L. Shrestha. President Dr. Ramesh Man Tuladhar delivered the welcome speech and handed over the Office of the Executive Committee to the newly elected President Dr. Megh Raj Dhital. Dr. Dhital then thanked all the members of the Society for electing him unanimously the President and highlighted upon the various issues, activities and approaches which the Society will be dealing in the coming days. One of the important points Dr. Dhital mentioned was to propose to hold Himalaya-Karakorum-Tibet Workshop (HKT) in Nepal in 2010. Then, he introduced all the members of the newly elected 13th Executive Committee. Chief Guest Dr. Madhav P. Sharma delivering his address made some suggestions the Society should take into account to develop Geoscience in Nepal. He thanked the Society for inviting him as Chief Guest and expressed happiness for having the opportunity to meet the Society members. Chairperson Mr. Pranab L. Shrestha thanking all the participants concluded the program.

In order to observe the **International Strategy for Disaster Reduction (ISDR) Day-2007 (**10 October 2007), the Nepal Geological Society, DP-Net and the Youth Network for Social and Environmetntal Development (YONSED) jointly organized two days programme in Kathmandu. On first day i.e. 9 October, 2007 (22Aswin, 2007), the *"Kathmandu Valley Interschool Art Competition"* was organized and the title for art competition was "Disaster: We and Our World". On second day i.e. 10 October 2007 (23 Aswin, 2064 B.S.) a day long workshop was organized. The theme of the workshop was 'Disaster Risk Reduction Begins at School' and was held at the auditorium of the Nepal Red Cross Society, Kathmandu. The workshop was inaugurated by the Chief Guest of the workshop, Minister of Finance Honourable Dr. Ram Sharan Mahat. The inaugural session of the workshop was chaired by the Honourable Member of the National Planning Commission Mr. Rama Kant Gauro.

The Nepal Geological Society organized the **Fifth Nepal Geological Congress** with grand success from 26 to 27 November 2007 at the Shanker Hotel in Kathmandu, Nepal. The theme of the Congress was *"Geology, Environment and Natural Hazard Mitigation: Key to National Development."* The Congress began with the Inaugural Programme during Session I. Finance Minister Dr. Ram Sharan Mahat inaugurated the Congress by lighting the traditional oil lamp. The Inaugural Session was chaired by Vice-Chancellor of Tribhuvan University Prof. Dr. Madhav P. Sharma. During the inaugural ceremony, *"The Honourary Fellowship of the Nepal Geological Society"* was conferred upon two eminent geoscientists Dr. Jovan Sebastian Stöcklin, Switzerland and Professor Dr. M. Qasim Jan, Pakistan in recognition of their contribution towards geoscientific researches and development of the Himalaya. The Congress was attended by distinguished geo-scientists from Nepal and abroad. Altogether, there were 197 participants from Nepal, India, Pakistan, Bangladesh, France, Japan, Switzerland and USA. Four Keynote addresses were made by eminent geoscientists namely Prof. Paul Tapponier, Dr. Jovan S. Stöcklin, Dr. Megh Raj Dhital and Prof. M. Q. Jan. Altogether 29 technical papers were presented by geoscientists from different countries during six technical sessions. There was also a Poster Session where three Poster Papers were presented. Scientific deliberations on 'General Geology, Tectonics and Seismicity were made on first three technical sessions. Technical Session V consisted of presentations on Engineering Geology and Geophysics. Next two technical sessions were assigned for presentations on Natural Hazards and Environmental Geology. The Congress concluded with the Valedictory Session with the expressions and thoughts about the Congress by participants from different geographic regions.

The Nepal Geological Society, Scientific Subcommittee and the Department of Geology, Tri-Chandra Campus jointly

organized scientific talk program on 21 September, 2007. The title of the talk program was *'Geological and Geotechnical Problems of Hydropower Development in Nepal'* and the deliberation was made by Mr. Subas Chandra Sunuwar, Senior Engineering Geologist. Similarly, another scientific talk program was organized on March 20, 2008. Professor Harutaka Sakai, Kyoto University, Japan presented on his research findings on Nepal Himalaya. The title of the scientific talk program was *'Uplift of Himalaya and History of Indian Monsoon'* and it consisted of three lectures. The first presentation was on *'When and how the Himalaya was born?*, the second lecture was on *'When and how the Kathmandu valley and Mahabharat range were born?* and the third lecture was on *'How the Indian monsoon evolve?*.

AWARD OF THE HONOURARY FELLOWSHIP OF THE NEPAL GEOLOGICAL SOCIETY

The Nepal Geological Society had conferred upon the Honourary Fellowship of the Nepal Geological Society to Dr. Jovan Sebastian Stöcklin of Switzerland and Professor Dr. M. Qasim Jan of Pakistan on the occasion of Fifth Nepal Geological Congress on 26 November 2007 in recognition of their contribution towards geoscientific research and development of the Himalaya. Honourable Minister of Finance Dr. Ram Sharan Mahat presented the Honourary Fellowship amid the ceremony during the inauguration of the Fifth Nepal Geological Congress.

NEPAL GEOLOGICAL SOCIETY

To all to whom these presents shall come, greeting:
In recognition of the contribution towards
geoscientific research and development of the Himalaya

Professor Dr M. Qasim Jan

has been conferred upon

The Honourary Fellowship of the Nepal Geological Society

with all of its privileges and obligations on this twenty-sixth day of November 2007
in Kathmandu, Nepal.

हिमालयको भूवैज्ञानिक अनुसन्धान तथा विकासमा विशिष्ट योगदान पुऱ्याउनु भएका

प्राध्यापक डा श्री एम. कासिम जानलाई

नेपाल भौगर्भिक समाजले २०६४ साल मंसिर १० गतेका दिन काठमाडौं, नेपालमा
यस समाजको सम्मानित सदस्यता प्रदान गरेको छ।

Dr Megh Raj Dhital
President
अध्यक्ष

Date: 26 November 2007
मिति २०६४ मंसीर १० गते रोज २ शुभम्।

NEPAL GEOLOGICAL SOCIETY

To all to whom these presents shall come, greeting:
In recognition of the contribution towards
geoscientific research and development of the Himalaya

Dr Jovan Sebastian Stöcklin

has been conferred upon

The Honourary Fellowship of the Nepal Geological Society

with all of its privileges and obligations on this twenty-sixth day of November 2007
in Kathmandu, Nepal.

हिमालयको भूवैज्ञानिक अनुसन्धान तथा विकासमा विशिष्ट योगदान पुऱ्याउनु भएका

डा श्री जोभान सेबास्टियान स्टोक्लिनलाई

नेपाल भौगर्भिक समाजले २०६४ साल मंसिर १० गतेका दिन काठमाडौं, नेपालमा
यस समाजको सम्मानित सदस्यता प्रदान गरेको छ।

Dr Megh Raj Dhital
President
अध्यक्ष

Date: 26 November 2007
मिति २०६४ मंसीर १० गते रोज २ शुभम्।

28TH ANNUAL GENERAL BODY MEETING OF THE NEPAL GEOLOGICAL SOCIETY, 31 AUGUST 2007

नेपाल भौगर्भिक समाजको अट्ठाइसौं साधारण सभा

Welcome speech by Dr Ramesh Man Tuladhar, President, Nepal Geological Society on the occasion of 28th Annual General Body Meeting

Respected Honorary Member (s)
Respected Past Presidents
Distinguished Members
Ladies and Gentlemen
Namaste! and a very Good Evening

On behalf of l2 Executive Committee, Nepal Geological Society and the capacity of its President, I am honoured to welcome you all to this important 28th Annual General Body Meeting of our Nepal Geological Society. "Zero hour" of 12 Executive Committee is approaching and therefore I would like to share some of my experience during our tenure-probably some are good and some are not so good. They are:

- Renewal of NGS at District Administration Office
- Registration in PAN and our No. is 302388105/KTM
- Applied for waiving Tax at District Administrative Office
- Subscription of NGS Journal to Central Library, Tribhuvan University, ICIMOD, BPC and Nepa Rastriya Pustakalya near future
- Completion of audit report three years
- Conducted one day seminar to observe UN/ISDR Day (2004, 2005 & 2006)
- Seminar on Geologic Controls of Groundwater in the Terai Region (April 2005)
- Conducted Fifth Asian Regional Conference (Sept. 2005)
- Observed Earthquake Safety Day (2061, 2062 & 2063)- Stall in Exhibition and Radio Programme
- Some scientific lectures
- NAST awards recipient Congratulation Program
- NGS 25 Anniversary (Silver jubilee) Samman Program
- Honoured two renowned geoscientics with NGS Honorary Member two more is being proposed for approval from today's AGM
- Established linkages with DP Net, UNDP and MoHA
- Publication of journals of NGS volumes 30,31,32 (Abstract), 33 and 35 is under progress.
- Bulletins of NGS (Name changed from News Bulletin to Bulletin of NGS

MoU with DMG (Nepal) and DASE (France) to publish Proceeding of International Workshop on Seismology, Siesmotectonics and Siesmic Hazards in the Himalayan Region, 28-29 November, 2006, Kathmandu, Nepal

Attended several meetings, seminars and workshops at National and International level (Mr. Rimal and Dr. Tuladhar attended series of International Seminar and Workshops organized by NGRI, Hydrabad, India).

Details will be elaborated by General Secretary Mr. Lila Nath Rimal and treasurer Mr. Jaya Raj Ghimire.

Distinguished Members!

To mention forthcoming events near future are-

1. Seminar to observe UN/ISDR Day, 10 October 2007, Theme: "Disaster Risk Reduction begins at Schools"

2. Fifth Nepal Geological Congress on "Geology, Environment and Natural Hazard Mitigation: Key to National Development"

Many more, I am sure will be coming up from the new leadership of Executive Committee. May I request all fellow members to participate actively in all forthcoming events of our Society?

The 13th Executive Committee, I am sure will be a strongest ever EC committed to do the best and only the best for the welfare of geoscientist at their endeavor. I wish them all my best.

Last but not least, I once again request all fellow members from the bottom of my heart to cooperate the 13 Executive Committee to move Nepal Geological Society a way forward.

Thank you.
Jaya Geosciences!

Best Wishes and

Hearty Felicitations

on

the Auspicious Occasion

of

Happy New Year
2065 B.S.

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Annual Report by Mr. L. N. Rimal, General Secretary, NGS delivered to the 28th Annual General Body Meeting

Respected Chairman
Honourable Chief Guest, Professor Dr. Madav Prasad Sharma, Vice chancellor, Tribhuvan University
Former Presidents
Respected Members of the Society

It is a pleasure to welcome you all to the 28 Annual General Body Meeting of the Nepal Geological Society on behalf of the 12 Executive Committee and myself. We have completed tenure of three years of the prestigious office of the Nepal Geological Society.

During the period we have put our efforts to the extent possible to enhance the activities of the society and fulfill its objectives. In this regard, I would like to inform you about the major works completed during the last year period.

Observing the ISDR day

The Nepal Geological Society in collaboration with the DP-Net organized a one-day workshop on 18 October 2006 on the theme 'Disaster Risk Reduction begins at school' announced by UN/ISDR. The ISDR-Day scheduled to be observed on every second Wednesday of October was postponed for third Wednesday of the month due to the Vijaya Dashami. The workshop was participated by more than 50 geoscientists and several intellectuals.

Celebrating the Earthquake Safety Day-2007

Society celebrated the Earthquake Safety Day-2063 by participating in the three-day long. Earthquake Safety Exhibition-2063 held at Basantapur Durbar Square, Kathmandu. A number of awareness raising posters and pamphlets were displayed on the occasion. Several thousand visitors attended the stall.

Renewal and Registration of the Society

Renewal of the registration of the Society in the District Administration Office, Kathmandu and registration in the Samaj Kalyan Parishad, Nepal has been done. Now our society has a PAN number. Necessary processes are initiated to acquire the tax redemption certificate.

Publication

The Bulletin of Society vol.24 as well as the Journal of Nepal Geological Society vol. 33 are published. We already started distribution to subscribers, members, and other institutions. We request all our members to purchase the journals and help towards making the publication sustainable. The Bulletin of the Society is distributed free of cost to our respected members. Proceedings of the Fifth Asian Regional Conference is in the final stage of editing.

Respected members of the Society,

The Society has gained a considerable strength in its membership. At present, the Society has 591members. 67 memberships are not renewed.

Dear Respected Members, I take this opportunity to inform about the activities of the society to be undertaken. ISDR Day 2007 will be organised on 10th of October.

Fifth Nepal Geological Congress is to be held on November 26-27, this year. The main theme of the congress is "Geology, Environment and Natural Hazard Mitigation: Key to National Development". We request the13th Executive Committee to follow up this matter. Further details about the congress will be elaborated by Dr. Megh Raj Dhital, convener of the congress later.

Dear members,

I offer my sincere thanks to various governmental and non-governmental agencies, organizations, consulting and business groups as well as international agencies and individuals for providing technical, logistic and financial supports to the society. Moreover, I hope that such cooperation will be continued in future also.

The Department of Mines and Geology has always been supporting the Society by providing all kinds of help at the time of Society's necessity. On behalf of the Society, I would like to express our sincere appreciation and acknowledgement to the Department of Mines and Geology.

We are equally thankful to Mountain Risk Engineering Unit of the Tribhuvan University for providing the space to the Editorial Board of the society to perform its activities. I offer my special thanks to the officials of the World Trade Centre for kindly providing this venue and necessary facilities.

We extend our sincere thanks to the chairman of election committee Mr. Gyani Raja Chitrakar and his team for

conducting the election of 13 Executive Committee smoothly. I would like to thank all society members for their continued help, cooperation and support during the year.

While working, there may have been shortcoming and weaknesses from our part. For this, I would like to take this opportunity to extend our sincere apology on behalf of the Executive Committee. At this moment, we would like to renew our request once again for the continuation of your support, advice and co-operation as well as to point out our weakness. We sincerely hope that the respected members of the Society will guide the new executive committee in the future.

Thank you all!

Annual Financial Report by Mr. Jaya Raj Ghimire, Treasurer, NGS presented during the 28th Annual General Body Meeting

नेपाल भौगर्भिक समाजका कोषाध्यक्ष श्री जय राज घिमिरेद्वारा प्रस्तुत आर्थिक प्रतिवेदन

यस सभाका सभापतिज्यू,
प्रमूख अतिथिज्यू,
सम्मानित सदस्यज्यूहरु,
यस सभाका पूर्व अध्यक्षज्यूहरु,
एवं सम्पूर्ण सदस्यहरु ।

सर्वप्रथम म नव निर्वाचित १३ औं कार्यकारिणी समितिका सम्पूर्ण पदाधिकारीहरुलाई बधाई दिन चाहन्छु । १२ औं कार्यकारिणी समितिको यो अन्तिम कर्यकाल रहेको छ ।

आज म यस १२ औं कार्यकारिणी समितिले आ.ब. ०६३।६४ को एक बर्षको कार्यकालमा गरेका आर्थिक विवरणलाई अधिकार प्राप्त लेखा परिक्षकबाट परिक्षण समेत गराई यस समाजको २८ औं साधारण्ण सभा समक्ष विगत बर्षमा जस्तै गरी तपाईहरु सामु पेश गर्न गईरहेछु ।

यसका मूख्य शिर्षकहरुमा भएको आम्दानी तथा खर्च तथा Receipt and Payment सम्बन्धी संक्षिप्त झलक तपाईहरु समक्ष पेश गरिनै सकेको छु । अब म यस सम्बन्धी मेटामोटी विवरण उल्लेख गर्ने अनुमति चाहन्छु ।

२०६३ श्रावण मसान्त (गत आ.ब. को अन्त्य) सम्मको Opening Bank Balance रु. २४,९९९,९५६।९३

यस आ.ब. ०६३।६४ मा भएको आम्दानी र खर्चको विवरण

आम्दानी	रु. १,२७,५४७।७३,
खर्च	रु. २,७३,१२२।९७
आम्दानी भन्दा बढी खर्च	रु. १,४५,५७५।२४

२०६४ असार मसान्त (यस आ.ब. को अन्त्य) सम्मको Closing Bank Balance रु. २१,३४,३१७८२

गत आ.ब.भन्दा कम Closing Bank Balance मा डलरको दर मूल्य कमजोर हुनु आम्दानी धेरै हुन नसक्नाले हो ।

अतः आर्थिक दुष्टिकोणले हेर्दा यो बर्ष समाजको लागि त्यती सन्तोषजनक बर्षको रुपमा हेर्न सकिदैन ।

अन्त्यमा, म यो विवरण सदस्यज्यूहरु समक्ष प्रतिकृया तथा सुझावको लागि पेश गर्दछु ।

धन्यवाद !

Auditor's Financial Report (FY 2062/63 B.S.)

Babu Raja Bajracharya
Registered Auditor

9 Bhadra 2064

The Members
Nepal Geological Society
Kathmandu

Gentlemen,

I have audited the attached Receipt and Payment Account for the year ended 32nd Asar 2064 and report as follows:

1. I have got all the information and explanations which are required for the purpose of audit.
2. Proper books as required are maintained according to Company's Law.
3. The attached Receipt and Payment Account and Income and Expenditure Account are drawn properly up in accordance with records which are made available.
4. According to the information given to me the attached Income and Expenditure Accounts prepared for the year ended 32nd Asar 2064 exhibit true and fair view.

Babu Raja Bajracharya
Registered Auditor

116 Teenkune Marga, Kuleswor, Kathmandu
Phone : 4282390

Water

Engineering & Training Centre (P). Ltd.

Working Areas

- Water and Wastewater
- Engineering
- Agriculture
- Environment
- Training and
- Research

Gas Chromatography Mass Spectrophotometer (GCMS)

Air Quality Monitoring

Services

- Design, Construction of Domestic, and Community Level Water Supply Schemes
- Wastewater Treatment and Management
- Bore Well Drilling and Well Design
- Training on Water Quality Analysis and Sanitation
- Water Quarity Monitoring and Assessment
- Environmental Monitoring and Assessment
- Ambient Air Quality Monitoring
- Noise Level Monitoring
- Consultancy for Industrial Environmental Monitoring

Noise Level Monitoring

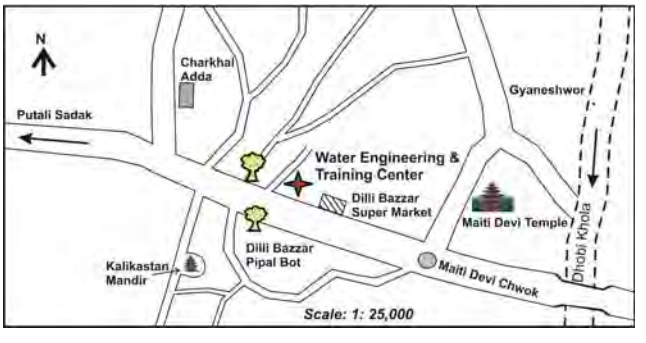
Water Treatment Plant

Laboratory Facilities

- Water and Wastewater Analysis
- Analysis of Solid Wastes
- Analysis of Pesticides
- Soils, Rocks and Minerals Analysis
- Constraction Materials Analysis
- Analysis of Food Additives, Feed Commodities and Beverages
- Analysis of Industrial Raw Minerals
- Others at Request

Contact Address

Dillibazar, Kathmandu, Nepal
Tel. No. 977-1-4418156,
Fax No. 977-1-4411642
G. P. 0. Box No. 8975,
EPC 5205, Kathmandu, Nepal



NEPAL GEOLOGICAL SOCIETY
INCOME AND EXPENDITURE ACCOUNT
For the year ended 32nd Asar 2064

EXPENDITURE	AMOUNT	INCOME	AMOUNT
To Advance	13,000.00	By Donation	45,000.00
To Audit Fee	5,000.00	By Entrance fee	200.00
To Advertisement	5,085.00	By Interest received	17,980.15
To Bank Charge	1,200.00	By Interest received ($223.48)	14,492.68
To Bank Charge ($13.43)	870.94	By Journal Sale	17,900.00
To Communication	15,471.00	By Life Membership fee	14,100.00
To Fuel	4,329.61	By Miscellaneous Income ($234)	15,174.90
To Hospitality	15,912.99	By Others	2,700.00
To Miscellaneous Exp.	2,928.00	By Excess of expenditure over	145,575.24
To Membership fee ($258.95)	16,792.91	income	
To Printing & Stationary	88,498.00		
To Postage	8,055.00		
To Remuneration,wages	50,840.00		
To Rent	18,000.00		
To Repair & Maintenance	1,700.00		
To Registration & renewal	18,165.00		
To Transportation	3,891.00		
To Tax on interest	1,209.10		
To Tax on interest ($33.53)	2,174.42		
Total	**273,122.97**	**Total**	**273,122.97**

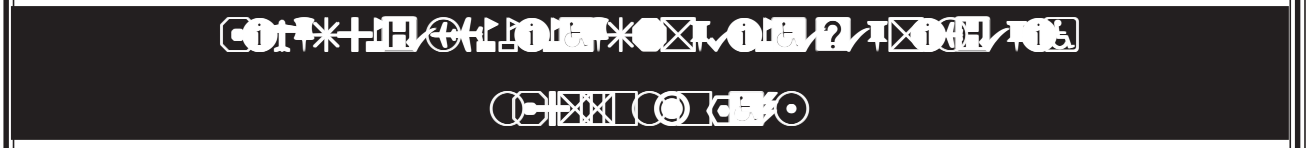
Note : US $1 = NRs.64.85

Treasurer	General Secretary	President	Auditor
J.R. Ghimire	L.N. Rimal	Dr. R.M. Tuladhar	B.R. Bajracharya

Some people think environmental degradation is inevitable sooner or later.

But we think otherwise.

For better environment and quality laboratory services, consult



Thapathali, Kathmandu, Nepal

Phone 4244989, 4241001 Fax No. 977-1-4226028

E-mail: ness@mos.com.np Website: www.ness.com.np

Ours is the first laboratory accredited by Nepal Bureau of Standards and Metrology under criteria of Singapore Laboratory Accreditation Scheme (SINGLAS).

Our specialised services include:

Surveying and consulting for environmental studies:

- Geological and Topographical Survey
- Meteorological and Geophysical Surveys
- Biological and Ecological Surveys
- Geotechnical Surveys

Chemical analysis/consulting services for environmental pollution control:

- Chemical analysis of potable water and waste water for a) Inorganic, b) Organic, c) Heavy metals and d) Pesticides
- Chemical analysis of solid wastes, soils, and dust particulates
- Monitoring ambient air quality in working environment
- Survey of noise and vibration pollution

Chemical analysis/consulting for any kind of raw materials, suppliers, makers, consumers and public works like:

- Food additives
- Chemical and chemical products
- Quality control tests for industrial products
- Analysis of rocks, soil, and sediments
- Study of special raw materials and their applications

Technical Services on:

- Environmental policies
- Air quality management
- Water/waste water management
- Industrial pollution management policies
- Design of pollution treatment systems
- AlE audit/monitoring
- Watershed management
- Consulting on socio-economic and engineering fields

Research and Development

NEPAL GEOLOGICAL SOCIETY
RECEIPT AND PAYMENT ACCOUNT
For the year ended 32nd Asar 2064

RECEIPT	AMOUNT	PAYMENT	AMOUNT
To Bank (opening)	2,483,989.33	By Advance	13,000.00
To Cash in hand(opening)	15,967.60	By Audit Fee	5,000.00
To Donation	45,000.00	By Advertisement	5,085.00
To Entrance fee	200.00	By Bank Charge	1,200.00
To Interest received	17,980.15	By Bank Charge($13.43)	870.94
To Interest received($223.48)	14,492.68	By Communication	15,471.00
To Journal Sale	17,900.00	By Fuel	4,329.61
To Life Membership fee	14,100.00	By Hospitality	15,912.99
To Miscellaneous Income ($234)	15,174.90	By Membership fee($258.95)	16,792.91
To Others	2,700.00	By Miscellaneous	2,928.00
		By Printing and Stationary	88,498.00
		By Postage	8,055.00
		By Remuneration,wages	50,840.00
		By Rent	18,000.00
		By Repair & Maintenance	1,700.00
		By Registration & Renewal	18,165.00
		By Transportation	3,891.00
		By Tax on interest	1,209.10
		By Tax on interest($33.53)	2,174.42
		By Misc.Loss(Diff. in Exchange Rate on $)	220,063.87
		By Balance	
		Nabil Bank(Saving)	35,003.41
		Nabil Bank(Fixed)	29,000.00
		Nabil Bank ($23288.82)	1,510,279.98
		Nepal Bank(Current)	9,949.68
		Nepal Bank(Saving)	52,996.35
		Agri. Dev. Bank(Saving)	442,088.40
		Agri. Dev. Bank(Fixed)	55,000.00
Total	**2,627,504.66**	**Total**	**2,627,504.66**

Note : US $ 1 = NRs.64.85

Treasurer	General Secretary	President	Auditor
J.R. Ghimire	L.N. Rimal	Dr. R.M. Tuladhar	B.R. Bajracharya

NEPAL GEOLOGICAL SOCIETY
TRIAL BALANCE
For the year ended 32nd Asar 2064

ACCOUNT HEAD	AMOUNT	ACCOUNT HEAD	AMOUNT
Advance	13,000.00	Entrance fee	200.00
Audit Fee	5,000.00	Interest received	17,980.15
Advertisement	5,085.00	Interest received ($223.48)	14,492.68
Bank Charge	1,200.00	Donation	45,000.00
Bank Charge ($13.43)	870.94	Journal Sale	17,900.00
Communication	15,471.00	Life Membership fee	14,100.00
Repair & Maintenance	1,700.00	Miscellaneous Income ($234)	15,174.90
Fuel	4,329.61	Others	2,700.00
Hospitality	15,912.99	Bank (opening)	2,483,989.33
Membership fee ($258.95)	16,792.91	Cash in hand (opening)	15,967.60
Miscellaneous	2,928.00		
Nabil Bank (Saving)	35,003.41		
Nabil Bank (Fixed)	29,000.00		
Nabil Bank ($23288.82)	1,510,279.98		
Nepal Bank (Current)	9,949.68		
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Agri. Dev. Bank (Saving)	442,088.40		
AGri. Dev. Bank (Fixed)	55,000.00		
Printing & Stationary	88,498.00		
Postage	8,055.00		
Registration & Renewal	18,165.00		
Remuneration, wages	50,840.00		
Rent	18,000.00		
Transportation	3,891.00		
Tax on interest	1,209.10		
Tax on interest ($33.53)	2,174.42		
Difference in $ Rate	220,063.87		
Total	**2,627,504.66**	**Total**	**2,627,504.66**

Note : US $ 1 = NRs.64.85

Treasurer	General Secretary	President	Auditor
J.R. Ghimire	L.N. Rimal	Dr. R.M. Tuladhar	B.R. Bajracharya

TRIENNIAL MEETING AND OFFICE HANDOVER CEREMONY OF THE NEPAL GEOLOGICAL SOCIETY, 31 AUGUST 2007

Speech by Dr Megh Raj Dhital, Newly Elected President of 13th Executive Committee of Nepal Geological Society during the Office Handover Programme

Respected Chairperson
Mr P. L. Shrestha, Director General,
Department of Mines and Geology,
Distinguished Chief Guest, Professor Dr M. P. Sharma
Vice-Chancellor, Tribhuvan University
Dr Ramesh Man Tuladhar, President
Other distinguished guests, fellow members,
Media personnel, Ladies and gentlemen:

First of all, I would like to express my sincere gratitude to you all for giving me an opportunity to be the President of the esteemed Nepal Geological Society. We also thank you for giving us the opportunity to work in this prestigious Thirteenth Executive Committee of the NGS. We are also indebted to those who took part in the last NGS elections and also to the members of the Election Committee who successfully organised the event. We also sincerely thank all those who gave their valuable time and suggestions during the General Body meeting this afternoon.

WORK PLAN OF THIRTEENTH EXECUTIVE COMMITTEE

For the purpose of making the NGS members more vibrant, dynamic, and competent, the Thirteenth Executive Committee has come up with a concrete plan of action or future programme. The work plan comprises the following six main themes.

1. Relationship building
2. Communication network building
3. Information dissemination and management
4. Outreach
5. Competence building
6. International exposure

1) Relationship building

The Thirteenth Executive Committee will work towards building the relationship between the NGS and other professional organisations, governmental organisations, NGOs, and INGOs. Some examples of such agencies could be Nepal Engineers' Association, UNDP, ICIMOD, European Commission, JICA, and USAID.

One of the methods of relationship building will be by organising joint seminars, joint short training programmes, interdisciplinary workshops, discussions on relevant topics, and organising joint talk programmes.

Some financial or other type of support from them will also be explored during the organisation of various NGS activities.

2) Communication network building

It was felt necessary to develop a stronger communication network between the NGS and its members in Nepal and abroad. It is necessary to keep the NGS members aware of all the forthcoming and implemented activities in time and seek their maximum participation, support, and co-operation.

The communication network building will be realised through regular emails, internet (NGS website), phone calls, letters, booklets, and pamphlets.

3) Information dissemination and management

In this age of information technology, we cannot live alone without information sharing and dissemination. Though the NGS is not capable to host a large website, we will try our best to update it in time and provide the latest information through it.

The information dissemination and management will be carried out in the following ways:

· NGS activities posted on the web with timely updates

· To make a member's portal where the name, affiliation, phone, email address, and other details of the member will be given together with her/his web address (if available and desired by the member)

· To post various announcements, news, and other relevant information for the benefit of the NGS members

· To put abstracts or full papers (free/paid) published in the Journal and News Bulletin, give the information about the forthcoming issues

· Mutual web link development among websites of various related organisations (such as other societies, TU library, Kantipur, Nepal News, ICIMOD, NATA) by quoting their websites in the NGS website and vice versa

· Free distribution of NGS Bulletin to other organisations and exchange of journals with other professional associations, societies, and publishers

4) Outreach

To make the NGS members more visible and important in the field of earth sciences, it was felt necessary to go and work with other agencies. Some planned activities are the following.

· Involvement with the media, such as NTV, Kantipur TV, Nepal Environmental Journalists' Forum, Sagarmatha TV, FM Radio by giving news, making small news clips, bulletins, documentary films, and discussion programmes on various earth-science topics

· In case of any earth science related hazards affecting the general public (such as earthquake, flooding, landslides, debris flows, and GLOF) and other events of NGS interest, there will be a timely response from the NGS side in the form of news release in the media, discussion forums, and information on the NGS web page.

· Organising exhibitions, film festivals, special programmes for school children, and 10+2 students on earth science and natural disasters.

· Interaction with the Gorkhapatra, Rising Nepal, Paryawaran, and other newspapers and journals by publishing relevant articles on various topics of the NGS interest.

· To seek further job opportunities in various governmental and non-governmental organisations through formal or informal discussions with respective authorities, request letters, and meetings.

5) Competence building

To widen the knowledge base of our members and interact with the professionals of other technical fields working in the same office as well as to show the competency of our profession, it is needed to update and strengthen our professional skills. For this purpose, the following plan is envisaged:

· Regular (monthly or bimonthly) talk programmes will be organised at various premises such as the Department of Mines and Geology, Tribhuvan University, Tri-Chandra Campus, Nepal Electricity Authority office, ICIMOD, and WECS.

· Short training programmes will be conducted for young NGS members on some needed topics

· NGS norms (standards) will be developed in various fields such as tunnelling, rock mechanics, soil mechanics, canal construction, road construction, groundwater, water quality and pollution, geological mapping, hazard mapping, earthquake-resistant structures, stratigraphy, and landslide mapping.

6) International exposure

To make the NGS community familiar with international activities, it is planned to carry out the following.

· To organise a GEOSAS conference in Nepal in the coming future (if possible, next year)

· To organise a HKT workshop in Nepal in 2010 or some other date

· To organise some invited guest lectures or talk programmes by international experts on special topics

We are seeking your valuable comments and advice on the above plan of action. If you have any other concrete suggestion, advice, or plan, kindly let us know. We will highly appreciate your participation in this process. Your comments and suggestions will be published in the forthcoming NGS Bulletin.

We are looking forward to working with you more closely and intimately.

Thank you!

Speech by Mr. Pranab Lal Shrestha, Director General, Department of Mines and Geology during the Office Handover Programme

Namaskar/Good afternoon to all.

Honourable Chief Guest, Professor Dr. Madav P. Sharma, Vice-Chancellor, Tribhuvan University,

President of Nepal Geological Society,

Dr. Ramesh Man Tuladhar

Incoming President, Dr. Megh Raj Dhital

Other Members of the Executive Committee

Distinguished Guests,

Ladies and Gentlemen,

I am thankful to the Nepal Geological Society for inviting me to chair the installation ceremony of its 13 Executive Committee. Indeed, this occasion has given me an opportunity to share experiences with the prominent geo-scientists of the countly who has been contributing their knowledge and efforts to develop the nation and educating the people.

So far geological complexity of the region/country is concern I should not go for lengthy lecture since all of us knew that where we are living and where we are standing. We cannot change its complexity but can learn or manage where we have to live or how we should stand. Of course there are many challenges in the universe, which are threatening the modern world, but natural disaster is the one that does not discriminate rich and poor and the major causes of this kind of disaster is due to insufficient attention given to this subject.

We all knew the importance of geo-science in the task of nation building and hence geo scientists are now inherent part of the team of scientists, technologists and engineers engaged in planning and implementing the development activities of the government.

It is a great pleasure to all the geoscientists that the planners, infrastructure developers and nation builders realized that geoscientists investigation is the must and done in the first and realized that one should go down the earth prior to build something on the top.

We are proud to say that Nepal Geological Society is conducting international standard workshops, seminars and symposiums regularly and it has publishing equal level of scientific journals and bulletins. The international scientists and geosciences communities have recognized its activities and have gained international reputation.

It is also please to know that the Nepal Geological Society is organizing a Fifth Nepal Geological Congress in this year. The Congress will provide a platform for presentation of geo-scientific research and work carried out by both the national and international geoscientist of the world community. I wish success of the congress.

Finally I would like to thank members of the 12th Executive Committee for their laborious effort in bringing the Society to this level and maintaining its reputation and status. I would also like to congratulate and best wishes to the success of newly elected incoming team of the l3 Executive Committee, which has taken up responsibility to lead the Society to new horizons.

Thank you!

FIFTH NEPAL GEOLOGICAL CONGRESS, 26-27 NOVEMBER 2007 KATHMANDU, NEPAL

Welcome speech by Dr Megh Raj Dhital, President of Nepal Geological Society and Convener of Fifth Nepal Geological Congress

Respected Chairperson, Professor Dr M. P. Sharma,
Vice-Chancellor, Tribhuvan University
Honourable Chief Guest, Dr Ram Sharan Mahat,
Ministry of Finance
Professor Paul Tapponier from France,
Professor Qasim Jan from Pakistan
Dr Jovan Stöcklin from Switzerland,
Respected Dignitaries,
Honorary Fellows of Nepal Geological Society
Former Presidents of Nepal Geological Society
Fellow members of Nepal Geological Society
Participants of the Fifth Nepal Geological Congress,
Business personnel,
Media personnel,
Ladies and Gentlemen:

It is my great pleasure to welcome you all to this inaugural ceremony of the Fifth Nepal Geological Congress. On behalf of the Nepal Geological Society and my own, I would like to thank our Honourable Chief Guest Dr Ram Sharan Mahat, Honourable Minister of Finance for accepting our invitation to inaugurate the Fifth Nepal Geological Congress. Similarly, we are also indebted to respected Chairperson Professor Dr M P Sharma, Vice-Chancellor of Tribhuvan University, for giving his invaluable time to chair the session.

As you all know, the theme of the Fifth Congress is Geology, Environment, and Natural Hazards Mitigation: Key to National Development. Since its establishment in 1980, the Nepal Geological Society is working towards the national development by disseminating the knowledge and skills in the field of earth science by organising various seminars, workshops, talk programmes and congresses. In 2005 we organised the Fifth Asian Regional IAEG Conference. We are happy to inform that it was actively participated by a large number of Nepalese as well as foreign delegates. I am confident that this Fifth Nepal Geological Congress will also prove to be a milestone in experience sharing and disseminating knowledge among the geoscientists gathered here.

The Nepal Geological Society has an excellent tradition to respect the geoscientists working in the Himalaya. On this occasion, we are honouring Dr Jovan Stöcklin from Switzerland and Professor Dr Qasim Jan, Vice-Chancellor of Qaed-e-Azam University, from Pakistan. Both of them are eminent scientists of their respective fields and have contributed a lot in fostering the earth science. We have also planned to briefly introduce their wonderful geoscientific activities on this occasion and deliver the award. I would like to mention that both of them accepted our invitation to come over here in Nepal and to take the award personally despite our rather short and late notice and their busy schedule. We highly appreciate their kindness.

I am confident that this Congress will be a memorable time to all of us and we all will be benefited a lot from it. As the proceedings of the Congress will be published in the Journal of Nepal Geological Society, I request all the paper presenters to submit their work for publication. With these few words, I would like to once again welcome you all to the Fifth Nepal Geological Congress.

Thank you!

Inaugural Speech by Honourable Minister of Finance Dr. Ram Sharan Mahat on the occasion of Fifth Nepal Geological Congress

Mr. Chairman,
Mr. President, Nepal Geological Society
Participants of the Congress
Distinguished geo-scientists of Nepal and abroad,
Ladies and Gentlemen

It is a great privilege and honor for me to be invited to this august gathering on inaugural ceremony of the "Fifth Nepal Geological Congress" organized by Nepal Geological Society. I thank the organizers for giving me this opportunity.

I am indeed happy to learn that Nepal Geological Society, since its inception has putting its efforts to the development of the geo-science in Nepal Himalayas. It plays an important role to the development of the nation through various research works in Nepal Himalayas by disseminating through its scientific publications, organization of various seminars, symposia, workshops etc. It is also facilitating for closer interaction between the geoscientists of different countries of the world. Their efforts are certainly to be commendable.

The Himalayan region certainly possesses natural resources, such as mineral resources and water resource. Systematic exploration and efficient exploitation of such minerals are essential for the development of the nation. I hope, the interaction of the Nepalese geoscientists with the international geoscientists will certainly enhances the knowledge of the Nepalese geoscientists that will help to explore and exploit the potential sites of such natural resources more effectively and efficiently.

Nepal situated on the lap of the Himalayas with complex geological structures is very fragile and consequently suffering from various natural disasters. This sought for thorough knowledge of the geoscientists and professionals in mitigating and preventing the natural as well as man made disasters. Moreover, application of their knowledge is also essential in the process of infrastructure developments, management of waste disposal, environmental protection and sustainable development in the country. I hope such gathering of eminent geoscientists from the SAARC region and abroad will certainly be beneficial not only to the Nepalese geoscientists and to professionals but for the foreign participants of the congress also. Such exchange of knowledge, I think will upgrade our knowledge further.

I am overwhelmed to know that more than 200 participants from different countries are participating to deliberate their research findings in this congress. The role of geoscientists has been increasing day by day in various stages of designing, planning and implementing policies, not only in national context but also in global scale. Geoscientfic inputs in infrastructure developments, engineering fields, management of natural resources, waste disposal etc. may be of national interest only where as the global environmental protection and sustainable development, mitigation and prevention of natural hazards etc. are of global interest. For this, we are in need of research, exchange of the findings, interaction, discussion, cooperation and collaboration of different geo-scientists. I think such events like the Fifth Nepal Geological Congress, certainly provide a common forum for it. The Nepal Geological Society deserves congratulation for organizing such congress in our own country.

I am glad to know that the Nepal Geological Society built capacity to coordinate the efforts of Nepalese geo-scientists and have a strong international relationship too. The network it has established makes it look like an international center that provides Nepalese geo-scientists an opportunity to effectively communicate with their counterparts from other countries.

It is also interesting to note that the Himalaya range has attracted such a large number of scientists from different countries. You have gathered here to discuss your hypotheses, your findings and identifying directions for future research. I take this meeting as a gesture of international cooperation of scientists for the upliftment of humankind as a whole. This congress, I am confident, will help in unfolding the geological mysteries of the Himalayan range.

I wish for successful deliberations, discussions and interaction over the outcomes of different researches carried by eminent geoscientists of different countries present in this two day long congress. In addition, I hope that you could come up with some comprehensive results that could provide guidelines necessary for the development of the respective nation and direction for future research. I welcome all the participants to this congress and wish for the success.

Thank You!

Speech by Professor Dr. M. Q. Jan on the occasion of the Fifth Nepal Geological Congress

Mr. Chairman

Mr. President, Nepal Geological Society

Participants of the Congress

Distinguished Geoscientists of Nepal and abroad

Ladies and Gentlemen

It is a great privilege and honor for me to be invited to this august gathering on inaugural ceremony of the "Fifth Nepal Geological Congress" organized by the Nepal Geological Society. I thank the organizers for giving me this opportunity.

I am indeed happy to learn that Nepal Geological Society, since its inception has putting its efforts to the development of the geosciences in the Nepal Himalaya. It plays an important role to the development of the nation through various research works in Nepal Himalaya by disseminating through its scientific publications, organization of various seminars, symposia, workshop etc. It is also facilitating for closer interaction between the geoscientists of different countries of the world. Their efforts are certainly to be commendable.

The Himalaya region certainly possesses natural resources, such as mineral resources and water resources. Systematic exploration and efficient exploitation of such minerals are essential for the development of nation. I hope, the interaction of the Nepalese geoscientists with the international geoscientists will certainly enhance the knowledge of the Nepalese geoscientists that will help to explore and exploit the potential sites of such natural resources more effectively and efficiently.

Nepal situated on the lap of the Himalaya with complex geological structures is very fragile and consequently suffering from various natural disasters. This sought for through knowledge of the geoscientists and professionals in mitigating and preventing the natural as well as man made disasters. Moreover, application of their knowledge is also essential in the process of infrastructure development, management of waste disposal, environmental protection and sustainable development in the country. I hope such gathering of eminent geoscientists from the SAARC region and abroad will certainly be beneficial not only to the Nepalese geoscientists and to professionals but for the foreign participants of the Congress also. Such exchange of knowledge, I think will upgrade our knowledge further.

I am overwhelmed to know that more than 200 participants from different countries are participating to deliberate their research findings in this Congress. The role of geoscientists has been increasing day by day in various stages of designing, planning and implementing policies, not only in national contests but also in the global scale. Geoscientific inputs in infrastructure development, engineering fields, management of natural resources, waste disposal etc. may be of national interest only where as the global environmental protection is of global interest. For this, we are in need of research, exchange of the findings, interactions, discussions, cooperation and collaboration of different geoscientists. I think such events like The Fifth Nepal Geological Congress certainly provide a common forum for it. The Nepal Geological Society deserves congratulation for organizing such congress in its own country.

I am glad to know the Nepal Geological Society built capacity to coordinate the efforts of Nepalese geoscientists and have a strong international relationship too. The network it has established makes it look like an international center that provides Nepalese geoscientists an opportunity to effectively communicate with their counterparts from other countries.

It is also interesting to note that the Himalaya range has attracted such a large number of scientists from different countries. You have gathered here to discuss your hypothesis, your findings and identifying directions for future research. I take this meeting as a gesture of international cooperation of scientists for the upliftment of humankind as a whole. The congress, I am confident, will help in unfolding the geological mysteries of the Himalayan range.

I wish for successful deliberations, discussions and interaction over the outcome of different researches carried by eminent geoscientists of different countries present in this two day long congress. In addition, I hope that you could come up with some comprehensive results that could provide guidelines necessary for the development of the respective nation and direction for future research.

I welcome all the participants to this Congress and wish for the success.

Thank you.

HAPPY NEW YEAR 2065 B.S.

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Vote of Thanks by Dr Danda Pani Adhikari, General Secretary Nepal Geological Society on the occasion of the Fifth Nepal Geological Congress

Respected Chairman, Prof. Dr. Madhav Prasad Sharma,
Vice Chancellor, Tribhuvan University, Kathmandu, Nepal
Chief Guest, Dr. Ram Sharan Mahat,
Honorable Minister, Ministry of Finance, Nepal
Dr. Jovan Sebastian Stöcklin,
Senior Geologist of Switzerland, and
Honorable fellow of Nepal Geological Society
Professor Dr. M. Qasim Jan,
Vice Chancellor, Quaid-e-Azam University, Islamabad, Pakistan, and Honorable Fellow of Nepal Geological Society
Professor Dr. Paul Tapponnier,
Member, French Academy of Science,
National Academy of Science, US, Physicist, IPGP
Dr. Megh Raj Dhital,
President Nepal Geological Society and
Convener, Fifth Nepal Geological Congress
High Government Officials
Honorary members of NGS
Past presidents of NGS
Distinguished Guests
Members of the Organizing Committee
Fellow Members of the NGS
Mrs Stöcklin
Scientists, Academia, Researchers, Media Personnels
Ladies and Gentlemen:

On behalf of the Nepal Geological Society, the organizing committee and myself, I am privileged to thank all the distinguished personalities and guests of the inaugural session and participants of the Fifth Nepal Geological Congress, **"GEOLOGY, ENVIROMENT, AND NATURAL HAZARDS MITIGATION: KEY TO NATIONAL DEVELOPMENT".**

We would like to express our sincere gratitude to Honorable Chief Guest, Dr. Ram Sharan Mahat, Minister, Ministry of Finance, for inaugurating the Fifth Nepal Geological Congress and delivering the comprehensive inaugural speech. Despite his busy schedule in resolving series of political issues in the country, he kindly accepted our invitation. Status of Geological activities plays an important role in economic and sustainable development of a country, but Nepal is seriously lacking behind to mainstream the geological knowledge in nation development. As Honorable Minister accepted our invitation to inaugurate the congress happily, we believe that he is aware of the importance of geology, and hope he will bring the correct message to the government for further strengthening of geological science in Nepal.

We are indebted to the Chairman, Professor Dr. Madhav Prasad Sharma, Vice Chancellor, Tribhuvan University, Kathmandu, Nepal for his encouraging speech. Dr. Sharma was one of the founder members of the Department of Geology in Tribhuvan University, and the ever first geologist guiding the first and the largest university in Nepal. TU is the only institution so far for geological education in Nepal. As he is now in the highest administrative position of Tribhuvan University, we believe, Tribhuvan University, in his leadership, will give high priority to strengthen the geological education and research activities.

The presence of Dr. J. S. Stocklin is very much encouraging to all of us. We, especially the young geologists in Nepal got him in the scientific literature and heard about his valuable contribution in the Himalayan geology, but did not see him before. The Nepal Geological Society and all of its members are very much happy to have this opportunity to honor him in this august gathering. We are also thankful to Mrs. Stocklin for accompanying Dr. Stocklin.

Similarly, we are very much grateful to Professor Jan for his presence. Despite his tight schedule and difficulties on the way, he managed to attend the ceremony and the Congress. We Nepalese should learn more from both Dr. Stocklin and Prof Jan. We appreciate their impressive and heartfelt speech.

Professor Dr. Paul Tapponnier is another well known name in the Himalayan research. He has been contributing a lot in the seismic study in Nepal. We are thankful for his valuable speech.

We also express our heartfelt gratitude to all the guests and participants, who accepted our invitation and came here to make the Congress a successful event.

In a country where promotion of Science and Technology is not a priority, and where peace is getting a dream, organizing scientific programme like this Congress is extremely difficult, mainly due to financial constraints. However, we were able to collect some funds from some organizations. The contributing organizations and persons who were involved in contacting and communicating them are duly acknowledged for their contribution and cooperation.

The Nepal Geological Society expresses its sincere gratitude to the following organisatins for providing the generous financial support:

Butwal Power Company Ltd., Kathmandu, Nepal
Cairn Energy PLC, Edinburgh, U. K.
Nepal Electricity Authority, Kathmandu, Nepal
Dhanvi Cement Pvt. Ltd., Nepal
Hetauda Cement Indusrty Ltd., Hetauda, Nepal
Himal Hydro and General Construction Company, Nepal
DDC-JV Middle Marshyangdi Hydropower Project, Udipur
SILT Consultancy Pvt. Ltd., Kathmandu, Nepal
Nepal Environmental and Scientific Services P. Ltd., Nepal

Similarly, the Nepal Geological Society also sincerely acknowledges the following institutions and organizations for financial support and kind co-operation:

DIP Consultacy (P.) Ltd.;
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Department of Geology Tri-Chandra Campus;
Department of Irrigation, GoN, Nepal
Petroleum Exploration Promotion Project, DMG, Nepal;
Department of Mines and Geology, GoN, Nepal; and
Department of Water Induced Disaster Prevention, GoN, Nepal.

The Department of Mines and Geology has always been supporting the Society by providing all kinds of help at the time of its necessity. On behalf of the Society, I would like to express our sincere appreciation and acknowledgement to the Department of Mines and Geology.

Organizing geological congress needs tremendous efforts. Members of the organizing committee and the secretariat of the Congress, who contributed their time and energy whenever required to make the Congress a success are duly acknowledged for their endeavor.

NGS constituted a committee of Professor Dr. B. N. Upreti, Mr. K. P. Kaphle, and Mr. A. M. Dixit, Past Presidents of NGS, to recommend the name of two honorary fellows. They worked hard in investigating the members, and finally came with the names of Dr. Stocklin and Prof. Jan for the fellowship. The organizing committee is grateful to Prof. Upreti, Mr. Kaphle and Mr. Dixit.

The organization of the Congress would not have been possible without the valuable contributions of papers and presentation by the distinguished experts in the following technical session. The organizer extends its sincere thanks to all the contributors.

Dr. Suresh Das Shrestha, who served as the Master of the Ceremony in the inaugural session is acknowledged for his time and cooperation. Our sincere thanks are also due to The Shanker Hotel for providing this venue for the Congress. We would also like to thank our media persons who convey our objectives to the general public. Finally, I thank you all for your gracious presence.

Thank you!

Glimpses of the Fifth Nepal Geological Congress

Honourable Minister Dr. Ram Sharan Mahat inaugurating the Fifth Nepal Geological Congress

Inaugural programme: Dignitaries at the dais

Participants of the Fifth Nepal Geological Congress ogranized by the Nepal Geological Society

Prof. Dr. Qasim Jan receiving the Honourary Fellowship of the NGS

Dr. Jovan S. Stöcklin receiving the Honourary Fellowship of the NGS

Chief Guest Honourable Minister of Finance Dr. Ram Sharan Mahat delivering the inangural address

RECOMMENDATIONS MADE BY THE FIFTH NEPAL GEOLOGICAL CONGRESS

1. There have been a number of infrastructural developmental activities such as road, dam, canal, and building constructions at the cities, towns and village and district levels. Owing to the lack of proper geological and geotechnical investigations many of such structures are damaged. At the same time they also trigger a number of landslides and debris flows during the monsoon season. To deal with such situations it is important to create a post for geoscientists in each District Development Committee and municipalities. These geoscientists can work together with the technical personnel and sociologists already working there. Only such an integrated and multidisciplinary effort can make these structures sustainable and hence proper utilisation of funds.

2. The pollution caused by brick kilns, stone crushers, cement factories, quarries, waste disposal and other similar activities carried out especially in urban areas is in increase. Therefore, the Government of Nepal should impose strict regulations to control such environmental problems creating health hazard. Due to rapid urbanisation, the industrial areas previously lying in the periphery of a city are already part of it. Therefore, there should be strict regulations to control the solid waste disposal, industrial affluent and hospital waste to protect soil, water, and air pollution from them. The highly polluting industries should be shifted at suitable sites away from urban areas and population centres.

3. Natural hazards such as earthquake, landslide, debris flow, flood, and glacier lake outburst flood (GLOF) should be properly investigated. The communities living in such vulnerable areas should be made aware of such disasters and early warning system to minimise the loss of lives and property.

4. Presently, hydropower projects, cement industries, coal mines, quarries, and infrastructures to be developed need detailed geological mapping. Therefore, such mapping should be extended to other parts of the country.

5. Presently surface and subsurface water is being used haphazardly, without following any rules and regulations. Therefore, there should be a water law for the proper extraction and utilisation of surface and groundwater.

6. Necessary laws should be constituted to control and regulate the mining of sand, gravel, dimension stones and rocks.

7. Large-scale infrastructure development works should be monitored and evaluated by geoscientists.

LIST OF VARIOUS SUBCOMMITTEES AND THEIR MEMBERS

Scientific Subcommittee

Dr. Santa Man Rai (TC, TU)	Coordinator
Mr. Pradeep Kumar Mool (ICIMOD)	Member
Mr. Uttam Bol Shrestha (DMG)	Member
Mr. Ashok Kumar Duvadi (DMG)	Member
Dr. Lalu Prasad Paudel (TU, Kirtipur)	Member
Mr. Sunil Shrestha (NEA)	Member
Mr. Khila Nath Dahal (DWIDP)	Member
Mr. Nir Shakya (GWRDB)	Member
Mr. Lila Nath Rimal (DMG)	Member

Work Plan of Scientific Subcommittee

1. Short-term (one-year) plan

a) Organise monthly talk programmes at the premises where the NGS members are based and such programmes fulfil their scientific need.

2. Long-term (three-year) plan

a) Organise various scientific and technical seminars, talk programmes, and workshops for the benefit of the NGS members and the general public.

b) Prepare an extended abstract of the talk programme and send the information as well as some photographs or news to the Communication Network Development Sub committee (Email address: ngs@wlink.com.np).

b) Work in close co-operation with the Communication Network Development Subcommittee, IT Subcommittee, Information Dissemination Subcommittee, the Editorial Board, and the Executive Body to dissipate the outcomes of such events.

Information Technology Subcommittee

Mr. Sudhir Rajaure (DMG)	Coordinator
Mr. Dharmaraj Khadka (DMG)	Member
Mr. Dinesh Nepali (DMG)	Member
Mr. Anantaman Singh Pradhan (TU)	Member

Communication Network Development Subcommittee

Mr. Lila Nath Rimal (DMG)	Coordinator
Mr. Pawan Budathoki	Member
Mr. Birendra Piya (DMG)	Member
Mr. Dinesh Napit (DMG)	Member
Mr. Kamal Duvedi (DWIDP)	Member

Land Management Subcommittee for NGS Building Construction

Mr. Sudarshan Prasad Adhikari (GWRDB)	Coordinator
Dr. Danda Pani Adhikari (TC, TU)	Member
Mr. Ashok Kumar Duvadi (DMG)	Member
Mr. Shardesh Raj Sharma (DMG)	Member
Mr. Swostik Kumar Adhikari (TC, TU)	Member

Standard Development Subcommittee

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Mr. K. P. Kaphle	Member
Mr. A. M. Dixit	Member
Dr. Suresh Das Shrestha	Member
Mr. Som Nath Sapkota	Member
Mr. Shree Ram Maharjan	Member
Mr. Surendra Raj Pant	Member
Mr. Durga Prashad Osti	Member
Mr. A. K. Duwadi	Member
Mr. A. N. Bhandari	Member
Mr. Sudarshan Adhikari	Member
Mr. Nir Shakya	Member

HIGHLIGHTS OF INTERNATIONAL STRATEGY FOR DISASTER RISK REDUCTION (ISDR) DAY-2007

The Nepal Geological Society (NGS), Disaster Preparedness Network (DPNet) Nepal, and Youth Network for Social and Environmental Development (YONSED) jointly observed the **International Strategy for Disaster Risk Reduction (ISDR) Day-2007** on 10 October, 2007 by organizing a two-day programme in Kathmandu, Nepal. The World Disaster Reduction Campaign for 2006-2007 was **"Disaster Risk Reduction Begins at School"** – *"Prakop Jokhim Niunikaran Aviyan Viddhalaya Bata Nai Suru Garaun"*. One of the basic ideas behind the theme is that schools are the best venue for sowing collective values. Through education, children need to be convinced about thinking and acting before the natural hazard event so that it becomes part of their normal thought patterns, values, decisions, culture and day-to-day actions throughout their lives and careers. Then, as these children enter the workforce, policies, behavior and actions related to thinking and acting before a natural hazard event becomes a disaster should follow. Some of the initiatives made immediate impact; others laid the foundations for future successes. But all help school children fulfill a role envisioned for them.

The programme in the first day was a *"Kathmandu Valley Interschool Art Competition"* and that in the second day was workshop on *"Prakop Jokhim Niunikaran Aviyan Viddhalaya Bata Nai Suru Garaun"*. The programme was supported by the UNDP Nepal, European Union, Action Aid, Oxfam, GEF and GEF Small Grant Programme.

Day 1: 9 October, 2007

Programme: Kathmandu Valley Interschool Art Competition

Title: ***"Prakop:Hami Ra Hamro Sansar"***

Disaster: We and our World

Venue: Basantapur Durbar Square, Kathmandu, Nepal

In a lively environment of Basantapur Darbur Square, Kathmandu, more than 50 students from 35 schools from Kathmandu, Bhaktapur and Lalitpur, maximum of two, one boy and one girl from a participating school, actively took part in the Art Competition. All the necessary materials, including colors, brushes and papers were provided by the organizer and the time provided to complete the art was four hours. The schools were previously contacted and registered and the students were accompanied by their teachers. The message to be conveyed in the art was **natural and human induced disasters around us and role of the students and society to mitigate them.** A panel, comprising of two senior artists and two disaster management experts was formed to perform art evaluation. Criteria set for the evaluation were beauty and presentation style and, coverage of the requested message in the art. Five best arts were selected out of the 50 arts and awarded with Rs. 5000 for the first, Rs. 4000 for the second, Rs.3000 for the third, Rs. 2000 for the fourth, and Rs. 1000 for the fifth arts. The prize distribution program was held in the next day.

A




Glimpses of students participating in the art competition in Basantapur Durbar Square, Kathmandu, Nepal

A disabled girl finilizing her art

An array of the completed arts

RESULT OF THE ART COMPETITION

Rank	Name of participant	Name of school	Painting No.
First	*Mr. Surendra Prajapati*	Shree Chamunda Higher Secondary School	31
Second	*Mr. Dhurba Sunuwar*	Shree Annapurna Higher Secondary School	3
Third	*Mr. Krishna Rijal*	New Summit High School	29
Fourth	*Mr. Bijaya Shrestha*	Shree Nava Yug Secondary School	45
Fifth	*Ms. Samita Bhasima*	Holy Garden English Secondary School	17

First prize winner

Second prize winner

Third prize winner

Fifth prize winner

Fourth prize winner

Day 2: 10 October, 2007
Programme: Workshop
Title: ***"Disaster Risk Reduction Begins at School"***
Venue: Nepal Red Cross Society Hall
Kalimati, Kathmandu, Nepal

The workshop was divided into three parts, inaugural, technical, and concluding sessions. The inaugural session was chaired by Mr. Badri Khanal, President, DPNet, Nepal, and the Chief Guest was Secretary of the Ministry of Education and Sports. A welcome speech was given by Dr. Meen Bahadur Chhetri, General Secretary, DPNet, and vote of thanks was given by Dr. D. P. Adhikari, General Secretary, NGS. Key note speakers, Prof. Dr. B. N. Upreti, the then Dean, Institute of Science and Technology, Tribhuvan University, Mr. Vijaya Singh, ARR, UNDP Nepal, Mr. Pratap Kumar Pathak, Joint Secretary, Ministry of Home Affairs, Mr. Lab Prasad Tripathi, Joint Secretary, Ministry of Education and Sports delivered their speeches and highlighted the importance of the disaster risk reduction activities in Nepal. At the end of the session, the chief guest distributed prizes and certificates to the top five artists and certificates of participation to all the students and schools participating in the art competition of the previous day.

In the technical session, a total of nine papers were presented in two sessions. Over 70 participants, including representation from academia, scientists, researchers, government ministries, decision makers, policy developers, NGO, INGO, and private organizations involved in the disaster related fields came together and actively took part in the workshop. A fruitful discussion was held following each discussion.

A final discussion was held following the presentations, and the workshop was concluded with a set of recommendations by summarizing the views raised by the participants. The abstracts of the papers presented in the workshop are given below.

ABSTRACTS OF PAPERS PRESENTED DURING THE INTERNATIONAL STRATEGY FOR DISASTER RISK REDUCTION (ISDR) DAY-2007 WORKSHOP

School level curricular provisions on disaster management in Nepal

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ABSTRACT

To provide general cognitive knowledge and develop positive attitude towards disaster management, school level curriculum on science, social studies, geography, population and environment have tried to address some issues. The curriculum covers the aspects of identification of natural disasters, its effects, and mitigative and preventive ways. In the Lower Secondary level, the curriculum focuses on the relation between development and environmental problems and natural resources protection. Similarly, the curriculum for the Secondary level gives emphasis on causes, effects and preventive measures, human impacts, and disaster management. The content includes landslide, flood, storm, soil erosion, earthquake, volcano, and their causes, effects and consequences.

Curriculum development center has done its best with the available resources, but there are number of problems in disaster management. Pedagogical adaptation on disaster management, which plays significant role in importing technical skills on students, teachers and even parents, is yet to be made.

Emerging trend, tools and techniques on managing disasters can be integrated and/or promoted through curriculum by initiating necessary efforts in text book revision and writing process. Initiation of orientation, awareness and empowerment activities at the national to grassroot level is planning to improve the existing drawbacks.

School based disaster risk reduction program: Importance and Challenges

***D. Pathak[1], A. P. Gajurel[1], G. B. Shrestha[1], D. P. Pathak[1], and S. K. Kafle[2]**
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ABSTRACT

Nepal is considered as one of the most disaster-prone countries in the Himalayan region as it is located in one of the youngest and fragile mountain ranges in the world. The flash flood, landslide, debris flow, glacier lake outburst flood (GLOF), fire and the epidemics affect a large population every year. These affected people are mostly the vulnerable group of people who are deprived of education, economy and approach to resources. Unless these issues are addressed at right time from right place, these socially marginalized communities and group of people will remain at high vulnerability to the locality specific disaster.

The Community Based Disaster Preparedness Program (CBDP) has been implemented in Nepal for more than a decade. The aim of the program was to organize and empower the local community with the knowledge and skills to carry out the disaster preparedness activities themselves with the support of local organizations. This program has approached the vulnerable people and has shown positive impact towards empowering the local community for the disaster preparedness and carry out responses during and after the disaster. However, still a large and most vulnerable population – the children were untouched and left behind to face the consequences of the disaster. In order to address this issue, the concept of school based disaster risk reduction program (SBDRRP) has emerged.

The present paper deals with the outcome of the study at 40 schools (in Bhaktapur, Chitawan and Syangja districts) under the coverage of the school based disaster risk reduction program of Nepal Red Cross Society. The concept of the program is that if the school children, teachers, and parents becomes aware about the hazards, disaster and are aided with the disaster preparedness tools and techniques, they can play the catalytic role to disseminate the knowledge to their friends and family who are the parts of vulnerable community. It is observed that the program has played a key role towards the capacity building of schools and the children on disaster preparedness. The program has significantly disseminated the knowledge on disaster preparedness. It is realized that this program with unique vision and approach has the potential to be replicated in other disaster prone areas of the developing country like Nepal. The identified challenge is to keep continued motivation and commitment of the stakeholders for the sustainability of the program through proper arrangement to overcome the financial constraints.

Disaster risk reduction and status of school education in Nepal

***D. P. Adhikari[1], B. N. Upreti[2], and S. M. Rai[1]**
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ABSTRACT

Nepal witnesses varieties of hazards - such as earthquakes, floods, landslides and debris flows, snow avalanches, heat and cold waves, epidemics, winds, rains, fires, dust/sand storms, lightening, and lifeline disruptions often resulting into heavy damage, destruction and casualties. Despite the disaster-prone circumstances, hazard issues are habitually sidelined because of limited technical, institutional and economic capacity combined with ongoing political games and faulty governance, lack of need driven education practice, and short attention spans.

In the face of increasing disaster risks to lives and property, it is globally agreed that education for disaster reduction and for global climate change must become an integral part of any educational strategy aimed at promoting and creating thriving and sustainable societies. The World Disaster Reduction Campaign for 2006-2007 *"Disaster Risk Reduction Begins at School"* has therefore given a worldwide impulse to efforts aimed at encouraging the integration of disaster risk education in school curricula in countries vulnerable to natural hazards and making school building safer to withstand natural hazards.

Global Climate change is emerging as an additional cause of natural disaster because the global temperature is rising in unprecedented scales, and is predicted to be as high as 6.4 ^{o}C by 2100 relative to 1990. In Nepal, temperature between 1977 and 2000 was raised by0.9 ^{o}C, whereas the global average surface temperature rise of the last century was 0.6±0.2 ^{o}C. Due to the observed changes of the last few decades, the frequency and severity of natural hazards resulting in disasters has risen dramatically, and is expected to rise far more in future. Climate impacts are therefore likely to be felt hardest in Nepal because its adaptive capacity is low due to limited human, financial and institutional and technological capacity. Realizing its importance, climate change has already become part of the school education worldwide, but Nepal has yet to know the importance and introduce it in school education.

One of the basic ideas behind the theme "*Disaster Risk Reduction Begins at School*" is that schools are the best venue for sowing collective values. Through education, children need to be convinced about thinking and acting before the natural hazard event so that it becomes part of their normal thought patterns, values, decisions, culture and day-to-day actions throughout their lives and careers. Then, as these children enter the workforce, policies, behavior and actions related to thinking and acting before a natural hazard event becomes a disaster should follow. Some of the initiatives made immediate impact; others laid the foundations for future successes. But all help school children fulfill a role envisioned for them.

Despite the urgent need of disaster risk reduction education in Nepal, there is full of weakness in our education system in terms of quantity, quality, and correctness of the textbook content and teaching methods. Another equally important aspect

is that school teachers are poorly trained on the Earth Science and Natural Hazard components because they never attended the course during their higher education study. Realizing the fact, Department of Geology, Tri-Chandra Campus conducted training courses on Earth Science and Natural Disasters for High School Science teachers of Kathmandu Valley. During the course of the training interactions, it was revealed that the school education on the Earth Science and Natural Hazard portions that has been given to our students since long time is insufficient and full of mistakes. In order to help reduce disaster risk, school education needs to be promoted with correct and standard content on natural hazard and climate change issue sufficiently, and the course needs to be designed by appropriate persons and the teachers need to be well-trained on the subject matters. One stitch in time saves nine!

School earthquake safety program: Strong tool for earthquake risk management in developing countries

***Ram Chandra Kandel, Surya Prasad Acharya, and Amod Mani Dixit**
National Society for Earthquake Technology–Nepal (NSET)
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ABSTRACT

School Earthquake Safety Program (SESP), a community based earthquake risk reduction program, is a continuous endeavor of National Society for Earthquake Technology – Nepal (NSET) being implemented in Nepal and other parts of the region since 1997. The strategy, approach, methodology and components of SESP were in fact evolved continuously at different stages of program implementation and have made the proagram unique and exemplary. It was started with structural vulnerability assessment of public school buildings in Kathmandu Valley and demonstration of seismic strengthening in one of the schools. However, during the implementation process need was felt to implement many new concepts like training of masons on aspects of earthquake-resistant construction, awareness raising and motivation to the community, education to students and teachers, and school emergency preparedness and response planning. Accordingly, these activities were included in the program and conducted successfully. Now, the SESP typically consists of physical assessment and seismic strengthening of the school buildings, on-the-job training of local masons, earthquake education to school teachers and students, development of earthquake preparedness and response plan for the school, and awareness-raising of community. The program is implemented with the involvement of community, related government authorities other key stakeholders like community organizations, donor agencies, local technical groups; this wide involvement helped to ensure the replication and sustainability of the program.

Till now, the program has been implemented in 95 government/ public schools of Nepal. The program has been accepted and recognized by the National as well as international agencies, UN agencies and is being widely replicated in the country and in the region. Recently, this program has also been implemented in the schools of Northern Areas of Pakistan jointly with UN/ISDR, which was considered as best tool for earthquake risk reduction activities. Recently, efforts are being made by NSET and other key agencies to develop strategy for institutionalization of the SESP concept at national level.

This paper intends to share the unique experiences of implementing School Earthquake Safety Program in Nepal and in the region, the nature and extent of community participation, and the lessons learned while implementing the program.

Disaster vulnerability and school safety

Prem Bahadur Thapa
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ABSTRACT

Disaster vulnerability is important concern to school safety because of the risk of more extreme reactions from the school children when disaster hit the school. The severity of children's reactions will depend on their specific risk factors. These include exposure to the actual event, personal injury or loss of a loved one, dislocation from their home or community, level of parental support, the level of physical destruction, and pre-existing risks, such as a previous traumatic experience

or mental illness. Therefore, school must be located in safer location where risk of disaster is low to very low. Unfortunately, many schools in developing countries like in Nepal are built in vulnerable areas i.e. low lying flood prone areas, alluvial fans and close to river banks. The main reason of construction of school in these spaces is due to lack of budget for purchasing lands and these abandoned vulnerable lands are usually available. Furthermore, those who are responsible for construction of school site have no in-depth knowledge of disaster consequences. There are several examples where such school sites were washed out or damaged by various kinds of disaster such as flood, landslide, earthquake etc. In order to reduce disaster risk in school, it is necessary to understand the disaster phenomena and probable vulnerability effects. Not only school must be constructed in safe places but also the school can be utilized as shelter house during the disaster events. These efforts eventually make school safe at the time of disaster; meanwhile other affected peoples will get shelter at the school.

Landslide disaster of Balyalta village, Achham district

***Birendra Piya and S. P. Manandhar**
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ABSTRACT

The annual loss of lives and property due to landslides and related disasters is significantly high in Nepal. The mountainous areas of Nepal are highly prone to landslide hazard. Every year many landslides occur along major thrusts, faults and fold axial traces as well as on dip slopes followed by monsoon rain and hundreds of people are killed by the landslides. Soil types, rock structure, precipitation, earthquake, and anthropogenic factors play a vital role in triggering of landslides. Considerable damages to lives and properties took place in the Balyalta village and its surroundings by landslide disaster, which was caused due to intensive rainfall that lasted for almost 3 days between 25 and 27 August 2006. Many landslides occurred in the specified area during the three days of continuous rain. The landslides were followed by some debris flows. This event took the life of 7 people and injured 10 others. Similarly 130 hectares of cultivated land was destroyed and 207 heads of cattle were killed by the debris flow. Similarly 92 families from Balyalta Village and 22 from Guta Village were displaced due to disaster.

ABSTRACTS OF PAPERS PRESENTED IN THE SCIENTIFIC TALK PROGRAMS

Geological and Geotechnical Problems of Hydropower Development in Nepal

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ABSTRACT

In the development of hydropower some major geological induced problems such as additional rock support, changing of tunnel alignment and slope instability are very common. These problems create great difficulties during construction increasing the project cost. Major problems are (1) additional rock support due to sudden change in rock mass quality, overbreak and rock squeezing, (2) changing of tunnel alignment due to poor geological conditions, and (3) Instability triggered by huge cutting of slopes with poor rock or soil. Thus geology determines not only construction cost, but it also affects long-term maintenance such as groundwater leakage. Case studies of such geological problems faced in different hydropower projects of Nepal are highlighted.

Uplift of Himalaya and History of Indian Monsoon

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ABSTRACT

The tectonic and thermal history of the Himalayan metamorphic nappe, which extensively covers the Lesser Himalayan autochthonous sediments, extending more than 100 km from the northern slope of Mount Everest to the southern margin of the Mahabharat range in eastern Nepal was studied by means of fission-track dating of detrital zircon and apatite and ^{40}Ar-^{39}Ar dating of mica in metamorphic nappe and underlying weakly metamorphosed early Miocene fluvial sediments in western Nepal.

A scientific drilling project carried out on the southern margin of the Kathmandu Basin, in other hand, revealed that muddy debris flow deposits dammed up the proto-Bagmati River and formed the Palaeo-Kathmandu Lake during the Jaramillo subchron from 1.07 to 0.97 Ma. Subsequent deposition of the alluvial fanglomerate, derived from the uplifting Mahabharat

Range to the south, raised the dam, deepening the lake. After 1 Ma, in the southern part of the basin, paleo-current directions changed from southward to northward, and deposition of gneissose and granitic detritus was replaced by sediments eroded from meta-sedimentary rocks exposed in the Mahabharat Range.

Palynological and sedimentological investigation on the sediment cores from Kathmandu revealed the terrestrial record of Indian monsoon during the middle to late Pleistocene. The palaeoclimate changes during the last ca. 600 kyr and millennial-scale climatic changes from ca. 15 kyr BP to 50 kyr BP revealed some interesting findings.

ARTICLES

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Quartz as main source of silica and its industrial uses

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ABSTRACT

Quartz is a common rock forming mineral that occurs as a main mineral in acidic and intermediate igneous rocks, metamorphic rocks and sedimentary rocks, metamorphic and sedimentary rocks. It has many varieties occurring purely as mineral deposit or as a major constituent in rocks. Nepal is a favorable geological environment for quartz mineralisation. Many quartz veins are recorde in geniss and schist in the Higher Himalayan region and in granite, schist and gneiss in the Lesser Himalayan regions. Several quartz bearing pegmatites and hydrothermal veins have been recorded in preliminary geological investigation from various districts of Nepal. At present two mines (Taplejung and Nawakot) are in operation in Nepal. Transparent quartz crystals are exported to third countries. Quartz has several industrial uses. As quartz has high potential of domestic and international markets, it is recommended that Department of Miners and Geology and private sectors should explore these resources and exploit them.

INTRODUCTION

Quartz is a common rock forming mineral that occurs freely as a main mineral constituent in almost all the igneous (except in basic and ultra-basic rocks), metamorphic and sedimentary rocks. It is usually found as vein quartz, or as constituent mineral in pegmatite, granite, gneiss and schist of the Lesser and the Higher Himalayan regions. As quartz has wide range of use, it is beneficial to explore and exploit it commercially.

PROPERTIES AND TYPES OF QUARTZ

Quartz is a member of tectosilicate group. It is usually colourless or milky white but frequently coloured due to presence of various impurities. It has hardness of 7 in Moh's hardness scale and has specific gravity of 2.65. It shows conchoidal fracture and mainly vitreous luster. The chemical composition is SiO_2. It is identified by its vitreous/glassy luster, conchoidal fracture and crystal form. The optical properties of quartz are colourless, transparent, weak birefringence, and positive uniaxial interference figure. It possesses strong piezoelectric and pyroelectric properties. Common types of quartz which occur in the rocks are as follows.

Rock Crystal: Rock crystal is the purest and most transparent form of quartz crystal (having SiO_2 > 99.8%). They mostly occur in the pegmatite or quartz veins/ dykes and as dog tooth spar in cavity fillings.

Vein quartz: Massive quartz obtained from the central core of zoned complex pegmatite and from veins, dykes and plugs within igneous and metamorphic host rocks. Most of the vein quartz deposits are believed to have formed by hydrothermal processes. They also occur as fissure and cavity fillings and less commonly as metasomatic replacement bodies.

Quartzite: Quartzite is a common metamorphic rock derived from sandstone/ arenite. Quartz is the chief mineral constituent in it. Its chemical purity can range from 95 - 99.8% SiO_2. Fine grained quartzite are suitable for the fabrication of millstone, grindstone etc.

Quart Arenite (Sandstone): It is a sedimentary rock which contains quartz as the chief mineral constituent. Its SiO_2 content is more than 95%.

Novaculite: It is a very dense, hard, fine grained highly siliceous rock (sp.gr. 2.63 – 2.64). Its chemical composition/ purity can exceed to 99% SiO_2.

QUARTZ OCCURRENCES, PROSPECTS, AND MINES

There exists favorable geological environment for quartz mineralization in Nepal. Occurrences of quartz veins and pegmatites are recorded mainly in gneiss, schist (crystalline rocks) in the Higher Himalayan region and in granite, schist and gneiss in the Lesser Himalayan regions. Many quartz bearing pegmatites and hydrothermal quartz veins are known from Taplejung, Ilam, Sakhuwasabha, Nawakot, Rasuwa, Dhadhing, Gorkha, Manang, Jajarkot, Bajhang, Bajura

Fig. 1: Quartz crystal from Khejemi, Taplejung, Eastern Nepal

Baitadi and Dadeldhura districts. Quartzites are the common metamorphic rock that occur both in the Higher and the Lesser Himalayan regions of Nepal. But they are yet to be evaluated for industrial use. However, quart crystals are mined from Raluka (Nawakot district in Nepal), Khejemi/ Sirku (Taplejung district in Nepal) in small scale by private sectors. Transparent quartz crystals are exported to Singapore, Japan, Switzerland, Germany, UK and USA. Production of Rock crystal/ quartz in the last five years is given in the table (Table 1). Two prospecting licenses and two mining licenses for quartz have been issued from Department of Mines and Geology (DMG). Only two mines (one in Taplejung and one in Nawakot) are in operation at present. Promising sites for such quartz have yet to be explored in many parts of the Higher Himalayan region. However, preliminary geological investigation indicates that there are better chances to find out high-grade/ pure quartz in the pegmatites along with other gem minerals like tourmaline, beryl/ aquamarine, garnet etc. in Nepal.

Amount of quartz varies considerably in different rock types. Silica is the main constituents in all silicate minerals. Hydrothermal quartz veins are the most common sources of electronic grade quartz crystal. Pegmatites associated with granite intrusion also yield very pure quartz. The cores of some of the pegmatite bodies commonly contain abundant fluid inclusions, which render the quartz unsuitable for fusing into clear quartz glass. Massive quartz veins of hydrothermal origin may have zoned structure. Quartz, quartzite, sandstone (arenite), silica sand, novaculite, flint, chert, vein quartz, rock crystals (quartz crystals) are the main sources of silica.

Primary quartz deposit may occur in the form of veins, pipes, pockets, stock-works and composite lodes confined to siliceous host rocks. They are composed mostly of very large transparent crystals or milky or gray coloured quartz that grew inward from the walls of druses cavities to form comb structure (Dog tooth spar). Vugs are lined with wall

Table 1: Quartz suitable for refractory purpose

formed quartz crystals (Fig.1). Most of the clear and electronic quartz crystals are smaller and weigh less than 250 g. Most Piezoelectric grade quartz, however, occurs as clear or translucent pyramidal terminations on milky quartz crystals that may weigh one ton.

INDUSTRIAL AND OTHER USES OF QUARTZ (SILICA)

Quartz has many uses. Some crystalline varieties like rock crystal, amethyst, rose quartz, citrine, smoky quartz, milky quartz and other cryptocrystalline varieties like chalcedony/ agate, flint, and jasper can be cut into gems and used in jewellery. Quartz is also used as an abrasive material, in mortar, sand paper, toothpaste, soaps, filter, paints, porcelain, foundries, and to manufacture glass, idol craft material, sodium silicate, ceramics, pottery, silica bricks, fused silicaware etc.

High purity metallurgical high grade silica (Quartz 99.5–99.82% SiO_2 avg.) is used in silicon metal and ferrosilicon alloys production. High grade quartz is also used for refractory, metallurgical and other uses. Depending upon its purity the best quality clear crystal with polished faced quartz is used in optical, electronic, and scientific apparatus. Depending on the piezoelectric properties quartz is used to control the frequency of radio circuits. In many countries high grade quartz is used predominantly in the manufacture of fused quartz ware for the electronic industries and other metallurgical uses.

Quartz is the chief source of silica. Impure quartzite and sandstone are used as building stone and paving stones. Some of the major uses are briefly mentioned below.

Metallurgical Use

Depending on the purity/quality of quartz they are treated differently for specific use. High quality crushed quartz or quartzite pebbles are used in the electric furnaces for the production of silicon metal, ferrosilicon (FeSi) and other silicon alloys. Metallurgical quality quartz is used in silicon alloys and as a flux in the smelting of elemental iron, nickel, zinc, copper, lead etc. Silica metal producers prefer to use quartz or quartzite lump that exceeds 2.54 cm diameter; and have a minimum softening point of 1700°C and do not decrepitates below 950°C. The rock/mineral should contain

at least 98.5 to 99% SiO_2 (preferably 99.3 to 99.8% SiO_2) and less than 0.01% Fe_2O_3, 0.15% Al_2O_3, 0.2% CaO, 0.2% MgO, 0.2% LOI. Fe_2O_3 and CaO are the critical impurities for metallurgical grade.

For Chemical Grade Silicon Production, Silica must have high reactivity and very low alumina 0.1% Al_2O_3 content and < 0.05% FeO_2, 0.005% CaO and 0.002% TiO_2. There should not be any phosphorus, sulphur, arsenic impurities at all. For Ferrosilicon Production, the producer can accommodate smaller lumps of silica rock ranging from 0.32 to 10.16 cm in diameter. It should contain >98% SiO_2, <0.4% Al_2O_3 (preferably <0.25%), <0.2% Fe_2O_3. Its alumina content influences the consumption of electric energy during smelting.

Acid Tanks and Towers: Acid towers can be packed with quartz gravel. It helps in drying and purification of gases e.g. chlorine.

Refractories: Quartzite and quartz pebbles are crushed and used as granister in manufacturing refractory bricks, tiles, kiln furnishing, mortars, Bessemer converters etc. Quartz suitable for refractory purposes is given in Table 1.

Steel making: In electric furnace quart/ silica helps to remelt scrap, in blast furnaces it helps to reduce iron ore pellets to pig iron and in basic oxygen furnace it helps to convert iron into steel. The principal use of silica rock in steel making is as acid flux and slag conditioner at blast furnace operation.

Abrasive Application: In grinding mills, Flint/quartz/ jasper must have high crushing strength/high hardness, high specific gravity, toughness/durability high purity, homogeneity, resistance to staining, fracturing, cheeping even in high temperature. Quartz or novaculite cut into whetstone, oilstone, files and other special shapes for craft uses.

Electronics and Optics: Natural electronic grade quartz crystal can be used in electronics and optics. Now a day, in the market synthetic crystals are replacing the natural crystal. For electronic and optics quartz crystals should weigh no less than 50 to 100 g. Piezoelectric grade crystals should contain no fracture, no liquid bubble inclusion, no rutile fibers, and no intergrowth with other minerals. The defective ones can be used in producing synthetic quartz crystals. Non piezoelectric grade pieces of ultra pure quartz that weight 10 to 30g can also be fused and fabricated into optical fiber performs (e.g. rods and tubing) precision optical and electro-optical blanks, billets and prisms, quartz ware apparatus etc.

Other Uses: Non whetstone grade novaculite is ground and used as filler/extender in latex paints, silicon rubber and plastic casting, molding and potting compounds such as for large electrical insulators. High purity quartz (river gravel) is used in 3 to 4 layers in air preheaters. It operates continuously at temperature 1165°–1294°C and is used in the thermal destruction of volatile organic compounds present in the off gases from industrial facilities. Rapid gravity filters at municipal water treatment contain quartz gravel of 2.54 cm at the base and 3.2 at the top (for total/thickness 30.5 to 45.7 cm). Quartz suitable for refractory purpose must have 99.19% SiO_2, 0.02–0.03% Fe_2O_3, 0.1 to 0.25% Al_2O_3 and 0.045% Na_2O+K_2O

EXPLORATION

In Nepal exploration of quartz as such has not been progressed. However, during exploration of gemstones especially tourmaline and beryl lots of pegmaties were studied and evaluated in different parts of the country. Some of the promising pegmatites for tourmaline and beryl are known from Sankhuwasabha, Ilam, Taplejung, Manang and Jajarkot area. Two private companies are engaged in mining crystal quartz in Raluka (Nawakot) and in Khejemi/ Sirku (Taplejung), Table 2. Two other Prospecting license holders are also exploring quartz in Nepal.

During the exploration of quartz a reconnaissance geological study is must to select the possible sites for large pegmatite bodies, vein quartz, quartzite, novaculite, sandstone etc. Once the site is identified follow-up detail investigation is required to calculate the tentative reserve of the deposit and its grade, i.e. amount of silica content in it. After that the evaluation of commercial potential normally requires:

- Drilling, drill core sampling, testing to calculate the reserve/ tonnage and grade (possible diamond drill) and prove the deposit.
- Chemical tests of the samples
- Economic evaluation and feasibility studies
- Industrial testing of samples

Table 2: Quartz production in Nepal

Fiscal Year	Total quartz production (Mt.)	Industrial quality (Mt.)	Gem quality (kg)	Mines in operation	Remarks
2002	173.720	172	1720	2 Small scale	Most of them are exported
2003	178. 265	176.5	1765	2 Small scale	Most of them are exported
2004	122.715	121.5	1215	2 Small scale	Most of them are exported
2005	110.292	109.2	1092	2 Small scale	Most of them are exported
2006	95.889	94.94	949	Small scale	Most of them are exported

If all these detail studies help to confirm the deposit as an economic one and appears feasible for mining then only the suitable type and environment friendly mining method is selected with a view to obtain maximum amount of mineable quartz reserve.

MINING AND PROCESSING

Vein type quartz deposits are generally small in size and irregular in shape. Therefore, in most cases they are mined by simple method in open pits. Whereas the large deposits with enormous quantities of quartz are extracted either by opencast mining or underground. To recover only a few kg of piezoelectric crystals huge amount of quartz has to be mined. The rest other than piezoelectric crystals are used for other purposes. In World War II, 40,000 m^3 of vein quartz was mined out, of that only 200 tons of rock crystal were obtained. Out of which only two tons of the crystals were suitable for piezoelectric application. Cloudiness, cracks, fluid bubbles, other inclusions and impurities etc. degrade the quality. Proper processing is highly important. Processing of metallurgical grade quartzite consists only of crushing, washing, and screening.

CONCLUSION

There is a high possibility to find pure quartz crystals in quartz veins and pegmatites, granites, schists, and gneisses in the Lesser and the Higher Himalayan regions of Nepal. Since the quartz can be used in many industries, the international market is very good. Therefore, it is recommended that DMG and private sectors should explore these resources and try to exploit/mine them.

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Gemstones of Northern Pakistan and their plate tectonic configuration

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ABSTRACT

Precious and semiprecious gemstone deposits occur in the Himalaya-Karakoram-Hindu Kush region (HKH), and dozens are reported from over hundred localities. Gemstones are chiefly of metamorphic, pegmatitic and hydrothermal origins. Geological studies show that gemstones are directly linked to the evolution of the greater Himalayan orogen.

INTRODUCTION

Northern Pakistan has seen a plethora of new discoveries of gemstones and mineral specimens over the past thirty years. The deposits occur in the Himalaya-Karakoram-Hindu Kush region (HKH), and the principal minerals include aquamarine, emerald, garnet, peridot, ruby, topaz, and tourmaline. But there are dozens of other minerals reported from over hundred localities, including minerals of the beryl, epidote, quartz, and spinel groups. As indicated by geological studies, these minerals are related to the geodynamic evolution of the greater Himalayan orogen.

GENESIS OF GEMSTONES

The closure of the Neo-Tethys led to welding of (1) Karakoram plate to Kohistan magmatic arc along the Shyok suture during the Late Cretaceous, and (2) Indian plate to the Karakoram-Kohistan assembly during Paleocene-Early Eocene. These events were preceded, accompanied and followed by extensive magmatism and metamorphism that caused the genesis of the gemstones.

Gems of Metamorphic Origin

The southern margin of the Karkoram plate (in Hunza valley) and the northern margin of the Indian plate have passed through chlorite to sillimanite grade regional metamorphism. Marble beds near the Karakoram Batholith contain a good quality ruby, accompanied by spinel (red, brown, blue), and grass-green pargasite. As in Hunza, marbles in Nangi Mali (Kashmir), Kaghan and, and possibly, Nanga Parbat massif also contain ruby corundum. Similar P-T conditions (600–650 ^{o}C, 5.5–6.5 kbar) have been proposed to have operated during their metamorphism. Considering the wide occurrence of medium-grade to high-grade metamorphic rocks, additional mineral discoveries are expected in the region.

Gems of Pegmatitic Origin

Tertiary magmatic activity in HKH was predominantly plutonic, and consisted of repeated pulses of granitic composition. These magmas were seemingly derived from diverse source materials through different mechanisms. Some were related to subduction, some to anatexis during high-grade metamorphism, and the Late Tertiary-Quaternary in the Nanga Parbat massif to rapid uplift. Small bodies of leucogranites, aplites, and pegmatites are abundant in Nanga Parbat, Kohistan arc, and Karakoram. A range of minerals has been reported from some of these pegmatites and associated quartz-feldspar (hydrothermal) veins. These minerals are tourmaline (colourless, pink, green, black), aquamarine (over 0.3 m long in rare cases) Be-minerals (morganite, beryllonite, hamburgite, herderite), topaz (colourless, brown, honey), zoisite-epidote (pink, green), Mn-rich garnet, quartz (including amethyst), fluorite, moonstone, sphene, rutile, apatite, zircon, axinite, light blue transparent albite, and many others. Of particular importance are the pegmatites (some zoned) on the eastern flank of the Nanga Parbat. High quality aquamarine and other minerals have also been reported from Shigar-Skardu, Hunza, Nagar, and Chitral. In Neelam valley, excellent crystals of yellowish to crimson red and tangerine garnet have been extracted from granitic pegmatites which may also have morganite, topaz and tourmaline. In Khaltoro area of Nanga Parbat, colourless to emerald green beryl occurs in pegmatites and quartz-albite-tourmaline veins in amphibolites (probable source of Cr) and granites. The gem pegmatites of northern Pakistan, fortunately, show little or no deformation. This suggests that they formed after the main phases of Cretaceous-Tertiary

tectonometamorphic-activity. Age data are scanty, but the zoned pegmatites on the eastern flank of the Nanga Parbat are <10 Ma.

Gems of Hydrothermal Origin

Perhaps the most important gemstones of Pakistan come from hydrothermal deposits. In addition to exquisite emerald, topaz, and peridot, there are hydrothermal garnet (green, honey, brown), chromian tourmaline (green), vesuvianite, epidote, and actinolite. With the exception of topaz, all these minerals occur in the Indus suture mélange. Emerald has been extracted from magnesite-talc/quartz rocks, quartz (with or without carbonate) veins and, rarely, from chloritic rocks and chromitites in Swat, Mohmand and Hajaur. Actinolites are associated with talc, whereas garnet and vesuvianite occur in metasomatised rocks. Further east in the suture zone at Sapat (Kaghan-Kohistan watershed), high quality peridot and yellow to green chromian garnet occur in serpentine matrix with some magnetite and ludwigite. These suture zone minerals are associated with ultramafic rocks and are probably related to hydrothermal alteration of the latter. One crystal of Sapat peridot weighs a kilogram. The Mingora emerald formation has been dated at 32 Ma. It is possible that beryllium and boron were carried by hydrothermal fluids either released from dehydration of the underlying Indian plate slab or are related to post-Early Tertiary magmatism.

Topaz of high brilliance and light to deep pink colour occurs along with milky quartz in calcite veins near Katlang, Mardan. The country rocks are little-deformed limestones of the cover sequence of the Lesser Himalaya. The topaz has been considered hydrothermal in origin. The source of the hydrothermal solutions is not known but they may be connected to the Late Paleozoic rift-related magmatism. Up to 0.12 m long crystals of orange brown parisite from Mulagori may be associated with the Warsak alkaline granites of this age.

CONCLUSION

Principal mineral deposits of Northern Pakistan in the HKH region include aquamarine, emerald, garnet, peridot, ruby, topaz, and tourmaline. Studies reveal that these minerals are directly related to the geodynamic evolution of the greater Himalayan orogen. Origin of gemstones is related to extensive magmatism and metamorphism resulted from Late Cretaceous and Paleocene-Early Eocene tectonics in HKH region. Few minerals like topaz and parisite are associated respectively with hydrothermal activity connected to the Late Paleozoic rift-related magmatism, and with the Late Paleozoic Warsak alkaline granites. If so, these will be the only gems in the HKH that are not related to the Himalayan tectonics.

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Regional scale slope stability analysis in Dhading district, central Nepal

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ABSTRACT

Landslides are the most common natural hazards in Nepal, where about 83% of the area are in the mountainous and hilly regions. In this study, a slope stability analysis on a regional scale was made for Dhading district, Nepal. The safety factor maps were produced for three steady state scenarios, i.e., completely dry, half-saturated and completely saturated soils. Stability diminishes from completely dry to completely saturated condition. In all three scenarios, very steep slope contributes to areas prone to failure, and areas having poorly graded gravel and clayey gravel have greater effects on instability of slopes than areas having other types of soil. A model based on the results of three scenarios yields that 27.71% of the study area is unconditionally stable, 0.59% is unconditionally unstable, and the rest is stable.

INTRODUCTION

Different approaches have been developed for slope stability analysis on a regional scale, for instance, Montgomery and Dietrich (1994), Van Westen and Terlien (1996), Borga et al. (2002) and Saha et al. (2002). GIS application for slope stability analysis requires the overlaying of various thematic layers as topography, soil types and landuse. The main purpose of the present study was to generate the safety factor maps on a regional scale so that these maps would be helpful in planning and designing developmental works, and in knowing the landslide prone areas.

The study area lies in the Dhusa Village Development Committee in Dhading district, Nepal (Fig. 1) and covers 347 km^2 area. The area lies within the latitude 27^o 45'00" to 27^o 52'30"N and longitude 84^{o}37'30" to 84^o 52'30"E with the altitude ranging from 245 to 1895 m above mean seal level. The areas having elevation less than 2400 m a.m.s.l. constitute phyllite, quartzite, limestone, dolomite, slates and granites, and subordinately constitute schists. Entisols cover major portion of the study area. Main landuse pattern in the area comprises agricultural land, bush and various forests. Low lying areas with slopes < 30^o are mostly influenced by human.

MATERIAL AND METHOD

Topographic, and landuse maps and geological maps were obtained from the Department of Survey, Nepal and Department of Mines and Geology, Nepal, respectively. All the maps were digitised. With the help of ArcGIS 8.1, these maps were transformed to raster maps with a grid size of 20 m by 20 m and a Digital Elevation Model (DEM) was prepared. A slope map was derived from DEM, and the slopes were classified into four categories: flat (<5 ^{o}), sloping (5–15 ^{o}), steep (15–30 ^{o}) and very steep (>30 ^{o}) slopes.

Based on the landuse map, nine types of land cover were identified as built-up area, cliff, agricultural land, forest, grass, bush, flood plain, barren land and water. Ten types of soils were identified from the study area and were clayey gravel, silty sand, organic silt, poorly graded gravel, inorganic silts, sandy clay, gravelly sand, silty gravel, poorly graded sand.

The slope stability factor (F) was calculated by the infinite slope method (after Skemton and DeLory 1957) using the following relationships:

$$F = \frac{C_s + C_r}{\gamma_e D \sin\theta} + \left(1 - m\frac{\gamma_w}{\gamma_e}\right)\frac{\tan\phi}{\tan\theta} \quad (1)$$

where, F is the safety factor, C_s and C_r are the effective soil and root cohesion (kN/m^2) governed by the soil and vegetation type respectively, D is the depth of the soil above the failure plain (m), ϕ is the angle of internal friction of the soil (^{o}), θ is the slope angle (^{o}), γ_w is the unit weight of water (kN/m^3), and γ_e the effective unit weight of soil (kN/m^3) as defined by van Westen and Terlien (1996) as:

$$\gamma_e = \frac{q\cos\theta}{D} + m\gamma_s + (1-m)\gamma_d \quad (2)$$

Fig. 1: Location of the study area in Dhading district of Nepal

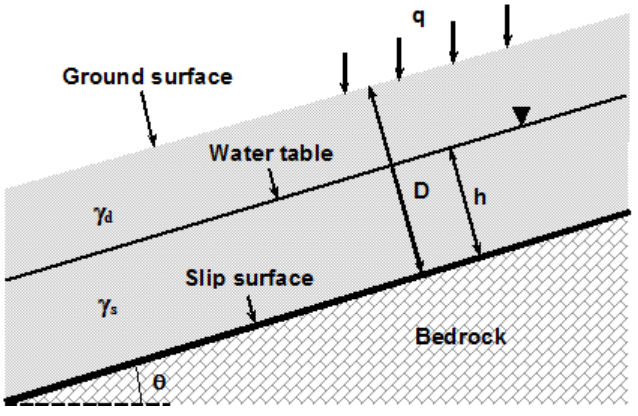

Fig. 2: Schematic representation of the infinite slope method depicting the various parameters and variables (adapted from Skempton and DeLory 1957)

where, γ_d and γ_s are the dry and saturated unit weights of the soil (kN/m^3), and q is the surcharge on the soil surface (kN/m^2).

Parameter 'm' in both equations represents the soil saturation index, expressing the relative position of the water table. The geometry of the slope and variables used in the equations are shown in Fig. 2 adapted from Skempton and DeLory (1957). DEM yielded the soil slopes, θ. The 'm' was taken as 1, 0.5 and 0 for completely saturated, half-saturated and completely dry conditions, respectively. Soil ϕ and C_s were adapted from Deoja et al. (1991), and C_r was adapted from Sidle (1991). Soil unit weights were taken from Ingles and Metcalf (1972). Surcharge was estimated according to the prevailing landuse pattern. Depth of the soil D above the bedrock or failure plane was estimated from landuse and was further corrected for the slope as the D decreased with steepness of the terrain. For areas with grass and bush the effective soil depth was assumed to be 1 m and for settlement and forest D was assumed 2 m in each case.

The flow chart (Fig. 3) illustrates parameters considered for calculation of factor of safety for three different scenarios.

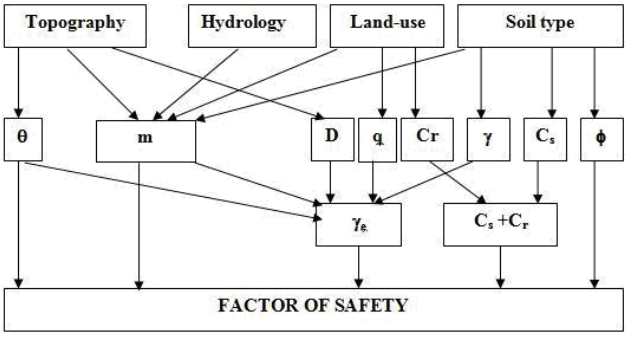

Fig. 3: Flow chart depicting the way of deriving slope stability safety factor maps from GIS data

As the stability of slope depends on F, it was categorised as: unstable (F<1), quasi stable (F = 1–1.25), moderately stable (F = 1.25–1.5) and stable (F>1.5). After producing maps for three different scenarios the final safety factor map was produced.

RESULTS

The stability of a particular hillslopes is dependent on the wetness index of the area and the steepness of slope. The safety factor maps under completely dry, half saturated and completely saturated conditions are shown in Fig. 4, Fig. 5 and Fig. 6, respectively. Under completely dry condition, the greater proportion of area is stable whereas under completely saturated condition, more area is unstable. Nearly 34.48% of total parcel of land is unstable under completely saturated condition whereas it is limited to 0.59% when the soil is in completely dry condition. Similarly, nearly 76.30% of the total land parcel is stable under dry condition wheras it is limited to 27.71% when the soil is in completely saturated condition. It is clear that there is decrease in stability from completely dry to completely saturated condition.

Slope stability based on landuse pattern

As the study area comprises mostly agricultural land (48.16%), bush (29.16%) and forest (20.09%), the stable class for these areas somewhat similar to that for the whole study area in different scenarios (Table 1). For individual landuse stability diminishes from completely dry to completely saturated condition. Variation of stability of grassland is negligible even the scenario changes. Grassland, flood plain, barren land and built-up areas are more stable compared to cliff, agricultural land, forest and bush areas, when each scenario is considered. Since the percentage of area in built-up area, grass, flood plain, barren land and cliff is very small (about 1.5%) as compared to the whole area, these areas have little effect in stability of slope in the study area.

Slope stability based on soil type

The study area comprises mostly clayey sand (18.29%), sandy clay (13.62%), silty gravel (12.63%), silty sands

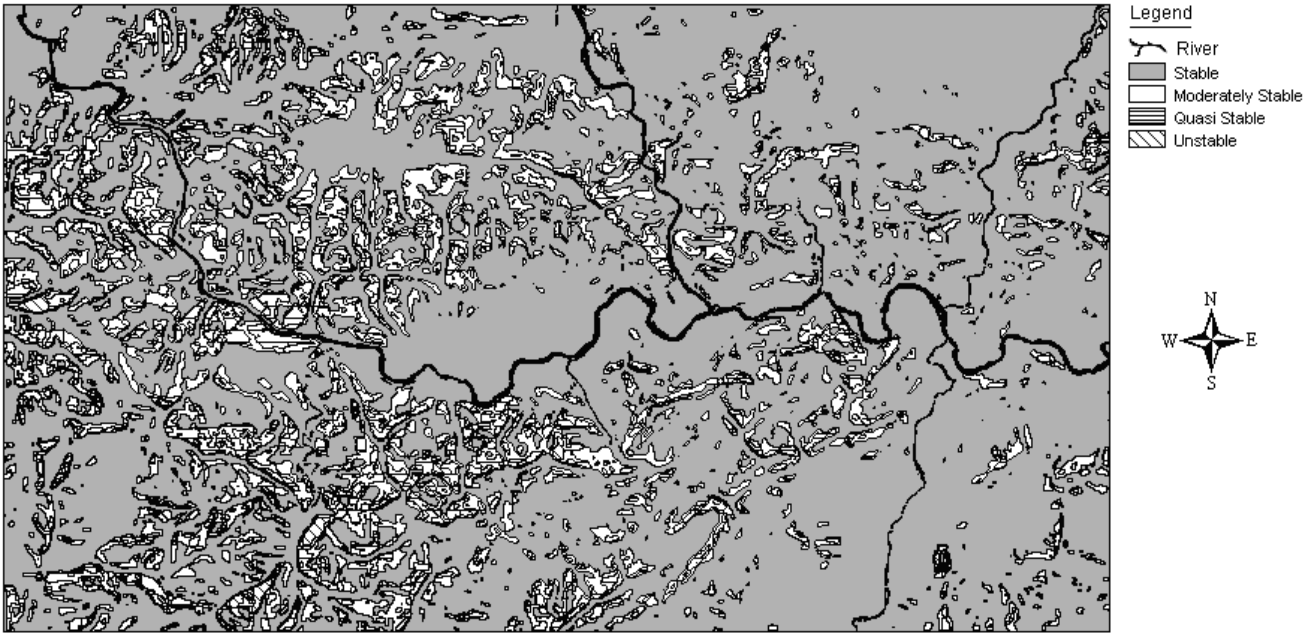

Fig. 4: Safety factor map for completely dry condition

Fig. 5: Safety factor map for half saturated condition

(10.00%), and poorly graded sand (9.83%). The stable class for these areas is similar to that for the whole area in different scenarios (Table 1). Similarly, for different scenarios, the percentage area in inorganic silts (10.00%), gravelly sand (1.25%) and organic silt (0.73%) are more in stable class than in the whole area. However, the percentage area in clayey gravel (8.25%), poorly graded gravel (4.15%) and bare rock cliff (0.16%) are less in stable class than in the whole area. As the percentage of area in gravelly sand, organic silt and bare rock cliff is very small (2.14%) compared to the whole area, these soils have little effect in stability of slope.

Slope stability based on slope type

The study area mostly comprises steep slope (49.17%) and very steep slope (34.89%). The percentage area in stable class for steep slope is higher and that for very steep slope is lesser compared to the percentage area in the whole area. In completely dry and half saturated conditions, greater area of

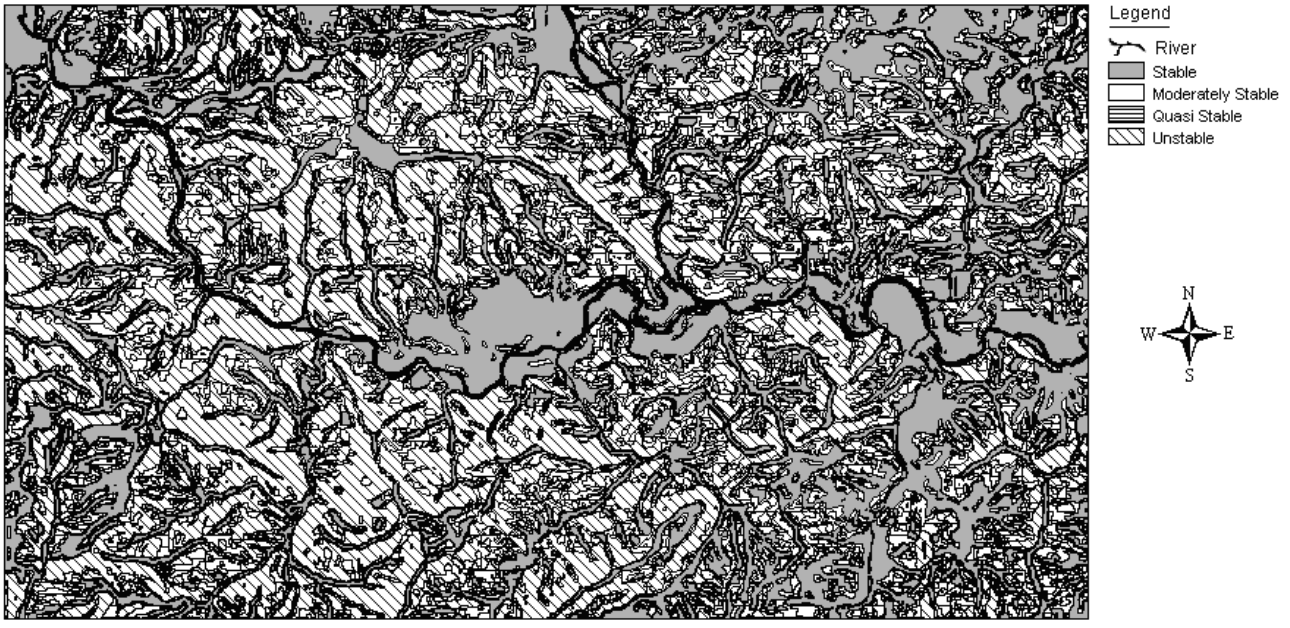

Fig. 6: Safety factor map for completely saturated condition

Table 1: Percentage distribution of stability classes for various scenarios in landuse type, soil type and slope types

	Completely dry				Half saturated				Completely saturated			
	S	**MS**	**QS**	**U**	**S**	**MS**	**QS**	**U**	**S**	**MS**	**QS**	**U**
Land use												
Built up area	96.25	3.75	0.00	0.00	76.45	17.41	6.14	0.00	48.12	23.21	20.48	8.19
Cliff	48.69	25.87	24.02	1.42	27.51	13.15	25.80	33.55	11.02	7.60	12.79	68.59
Agriculture	76.75	15.98	6.77	0.49	50.32	18.42	21.86	9.40	29.83	12.18	20.60	37.39
Forest	75.11	17.81	6.31	0.77	45.56	23.00	23.88	7.57	22.63	14.97	27.09	35.31
Grass	100.0	0.00	0.00	0.00	100.0	0.00	0.00	0.00	95.96	4.04	0.00	0.00
Bush	75.53	17.07	6.75	0.65	47.63	23.39	21.54	7.44	25.46	16.50	27.87	30.17
Flood Plain	98.27	1.18	0.37	0.17	92.81	3.54	2.50	1.16	79.39	7.13	6.16	7.32
Barren land	94.44	4.17	1.39	0.00	89.58	3.47	3.47	3.47	80.56	3.47	6.94	9.03
Soil type												
Clayey sands	77.33	15.82	6.45	0.40	49.80	20.24	21.58	8.38	29.48	12.64	22.79	35.10
Poorly g. sands	77.90	17.15	4.84	0.11	44.45	23.02	24.93	7.60	20.35	12.80	24.77	42.07
Silty gravel	73.65	18.04	7.49	0.82	49.98	19.49	22.73	7.80	28.29	15.16	23.28	33.27
Gravelly sands	98.31	1.14	0.37	0.18	92.91	3.49	2.44	1.16	79.50	7.11	6.12	7.26
Sandy Clay	77.48	16.52	5.42	0.58	46.29	24.00	22.34	7.38	24.72	15.55	27.89	31.84
Bare rock cliff	48.72	25.85	24.01	1.42	27.56	13.14	25.78	33.52	11.08	7.60	12.78	68.54
Inorganic silts	89.63	7.98	2.33	0.06	64.94	19.18	12.24	3.64	39.82	17.03	24.03	19.11
Poorly g. gravel	61.56	21.19	15.13	2.12	37.10	15.53	25.50	21.87	19.86	9.52	16.56	54.06
Organic silts	97.95	2.05	0.00	0.00	74.42	19.53	5.85	0.20	36.65	28.92	26.75	7.68
Silty sands	70.90	20.55	8.26	0.29	44.71	20.04	25.78	9.47	23.68	14.03	23.29	39.00
Clayey gravel	66.09	22.04	10.01	1.86	39.10	22.95	27.16	10.79	20.30	13.53	27.48	38.69
Slope type												
Flat	100.0	0.00	0.00	0.00	100.0	0.00	0.00	0.00	100.0	0.00	0.00	0.00
Sloping	100.0	0.00	0.00	0.00	100.0	0.00	0.00	0.00	99.41	0.59	0.00	0.00
Steep slope	96.99	3.01	0.00	0.00	64.50	25.35	10.13	0.02	25.47	25.16	32.58	16.79
Very steep slope	37.04	42.53	18.75	1.68	5.55	22.80	47.92	23.73	0.00	3.97	21.86	74.17
Study area	**76.30**	**16.49**	**6.61**	**0.59**	**49.09**	**20.61**	**21.92**	**8.38**	**27.71**	**13.95**	**23.86**	**34.48**

the steep slopes falls under stable class compared to the whole area, but under saturated condition the percentage is more or less similar. Considering the flat slope, almost all the areas are falls under stable class in each scenario. It reveals that steepness plays an inmportant role in slope stability.

Slope stability based on final factor of safety map

For the whole area, 27.71% of the area is unconditionally stable, 13.95% stable, 23.86% moderately stable, 26.10% moderately unstable, 7.79% unstable and 0.59% is unconditionally unstable (Table 2, Fig. 7). Built-up area, agricultural land, grassland, flood plain and barren land are more stable compared to the other landuse categories. Percent area under different categories for agriculture land, forest, and bush is similar to that of the whole area. Poorly graded sand, bare rock cliff, poorly graded gravel, silty sand and clayey gravel mostly fall under moderately unstable category, whereas most of the areas of clayey sands, silty gravel, gravelly sand, inorganic silt and organic silts fall under unconditionally stable category. For the slope categories, flat and sloping areas are almost unconditionally stable, but steep slopes are unconditionally stable to moderately stable. However, nearly 50% of very steep slope area lies on moderately unstable categories. This reveals that the steepness has adverse effect on the stability of slope.

Table 2: Percentage distribution of stability classes for different landuse types, soil types and slope types in the final safety factor map

	Area in percentage					
	Unconditionally Stable	**Stable**	**Moderately Stable**	**Moderately Unstable**	**Unstable**	**Unconditionally Unstable**
Land use						
Built up area	48.12	23.21	20.48	8.19	0.00	0.00
Cliff	11.02	7.60	12.79	35.04	32.13	1.42
Agriculture	29.83	12.18	20.60	27.98	8.91	0.49
Forest	22.63	14.97	27.09	27.74	6.80	0.77
Grass	95.96	4.04	0.00	0.00	0.00	0.00
Bush	25.46	16.50	27.87	22.73	6.78	0.65
Flood Plain	79.39	7.13	6.16	6.16	0.98	0.17
Barren land	80.56	3.47	6.94	5.56	3.47	0.00
Soil type						
Clayey sands	29.48	12.64	22.79	26.71	7.98	0.40
Poorly graded sands	20.35	12.80	24.77	34.47	7.49	0.11
Silty gravel	28.29	15.16	23.28	25.46	6.98	0.82
Gravelly sands	79.50	7.11	6.12	6.10	0.99	0.18
Sandy Clay	24.72	15.55	27.89	24.46	6.80	0.58
Bare rock cliff	11.08	7.60	12.78	35.01	32.10	1.42
Inorganic silts	39.82	17.03	24.03	15.47	3.58	0.06
Poorly graded gravel	19.86	9.52	16.56	32.19	19.75	2.12
Organic silts	36.65	28.92	26.75	7.47	0.20	0.00
Silty sands	23.68	14.03	23.29	29.53	9.18	0.29
Clayey gravel	20.30	13.53	27.48	27.90	8.93	1.86
Slope type						
Flat	100.00	0.00	0.00	0.00	0.00	0.00
Sloping	99.41	0.59	0.00	0.00	0.00	0.00
Steep	25.47	25.16	32.58	16.77	0.02	0.00
Very steep	0.00	3.97	21.86	50.44	22.05	1.68
Study area	**27.71**	**13.95**	**23.86**	**26.10**	**7.79**	**0.59**

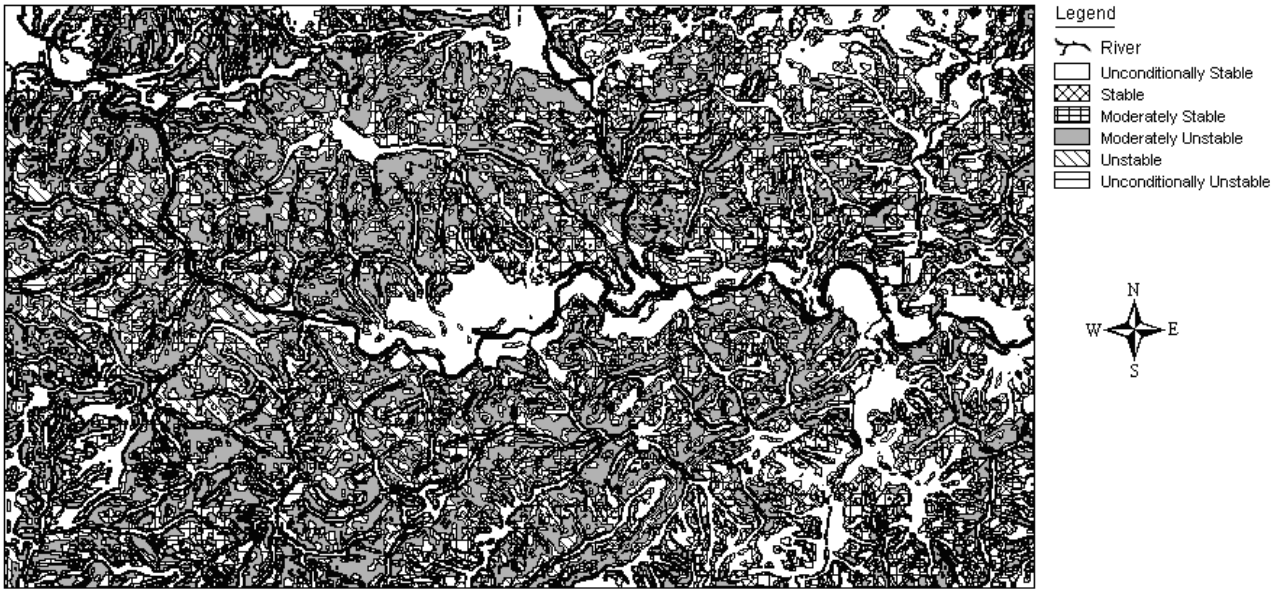

Fig. 7: Final safety factor map

CONCLUSION

Most of the natural slope failures occur during the rainy seasons, as the presence of water causes both increased stresses and the loss of strength. Natural slope instability in steep mountainous terrain is a major concern where failure might cause catastrophic distribution on the surrounding area. The stability of a slope is generally viewed in relative terms. It is obtained that there is a decrease in stability from completely dry condition to completely saturated condition. In all scenarios, very steep slope area (having slope angle >30^{o}) contributes to areas prone to failure. In addition, areas having poorly graded gravel and clayey gravel have more effect in instability of slope than areas having other types of soils. The regional analysis based on GIS is especially useful for remote regions where detailed information is not available. However there are some limitations on scarcity of well-organized data, heterogeneity of soil properties in micro scale, and question on reliability of constants used depending on soil types.

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Status of soil erosion in Khajuri watershed, Siwalik Hills, eastern Nepal

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ABSTRACT

Soil erosion and related phenomena prevail in the Khajuri Watershed. The study area lies in the south of the Central Churia Thrust and north of the Himalayan Frontal Thrust. This paper focuses on the data collected from gullies, erosion plots and stream banks during 2002, 2003 and 2004. The iron pin method was applied in monitoring soil erosion.

INTRODUCTION

Soil erosion is a major problem that deteriorates agricultural land and depletes the nutrients from the watershed. The present study was undertaken to find out a net erosion rate from a small watershed of the Siwalik Hills. The study area is situated in the Khajuri watershed, Udayapur district in eastern Nepal (Fig. 1). The maximum and minimum elevations of the Siwalik Hills are 400 m in the southern part and 160 m at the confluence of the Trijuga and the Khajuri Kholas. The watershed received 1732 mm and 1721 mm rainfalls in the year 2002 and 2003, respectively, and of these, 85% of rainfall occured between June and August. The floods in the study area were characterised by sudden increase in peak flow with high erosion potential (Ghimire et al. 2001).

The study area comprises Quaternary terrace deposit and Tertiary to Pleistocene bedrock (Fig. 2). The terrace deposit covers about 30% of the watershed. The bedrocks comprise the Upper Siwaliks, Middle Siwaliks and the Lower Siwaliks, which extend NW-SE. The trunk river of the Trijuga River flows over the terrace deposit, whereas the Khajuri and Musahar Kholas flow towards NE, across the strikes of the bedrocks to contribute the Trijuga River.

METHODOLOGY

The watershed was studied from June 2002 to August 2004 accompanied by regular field visits. The monitoring sites were selected on the basis of experience of erosion prone areas (Deoja et al. 1991; Daisuke 1998) and flooding, and aerial photographs. Iron pins were applied to measure the soil erosion rate. Despite of some limitations in using this method, it was tried to minimize. The observation points were monitored at different gully, erosion plot and stream bank stations (Fig. 3).

Five gullies, all of which were located in the Middle Siwaliks, were monitored (Figs. 2 and 3). The active gullies were monitored for their head, banks, width and slope for determining the rate of erosion. Four erosion plots (> 20 m^2) were selected on the basis of land cover, slope and geology.

Four erosion plots, two in the Middle Siwaliks and two in the Upper Siwaliks (Figs. 2 and 3) were monitored at least twice a year, one prior to monsoon and another after the monsoon. The erosion plots were grided, and iron pegs were inserted for monitoring.

The Khajuri Khola and the Musahar Khola banks were observed at ten different sites (Fig. 3). Three bank stations were placed on the Quaternary terrace deposit, three in the Upper Siwaliks, and the remaining four were placed in the Middle Siwaliks. The very active banks were monitored with the reference of the stable structures as trees and large boulders. The moderately stable and active banks were monitored by directly inserting the painted iron pegs. The expansion of banks was also measured at fixed site at different times.

RESULTS

Estimation of soil erosion

The gross sediment production refers to the amount of sediment eroded and removed from the source. Generally, sediment yield is the total amount of eroded sediment discharged by a stream at any point. Before the sediment leaves the watershed, the eroded sediment is deposited inside

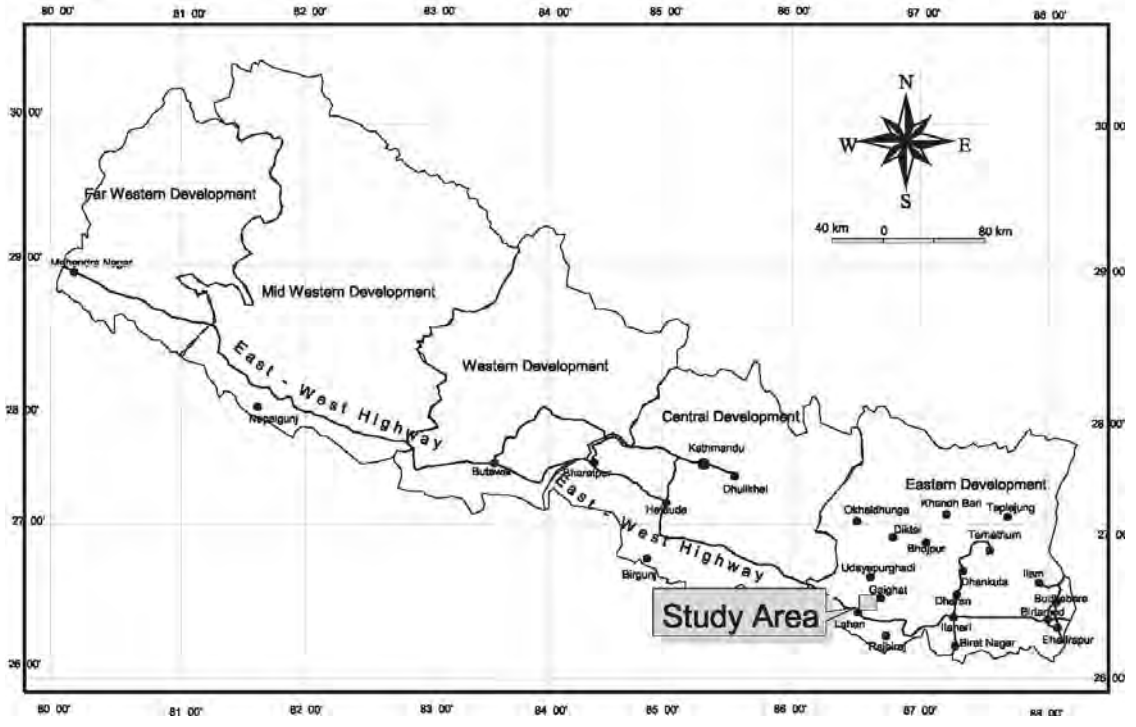

Fig. 1: Location map of the study area

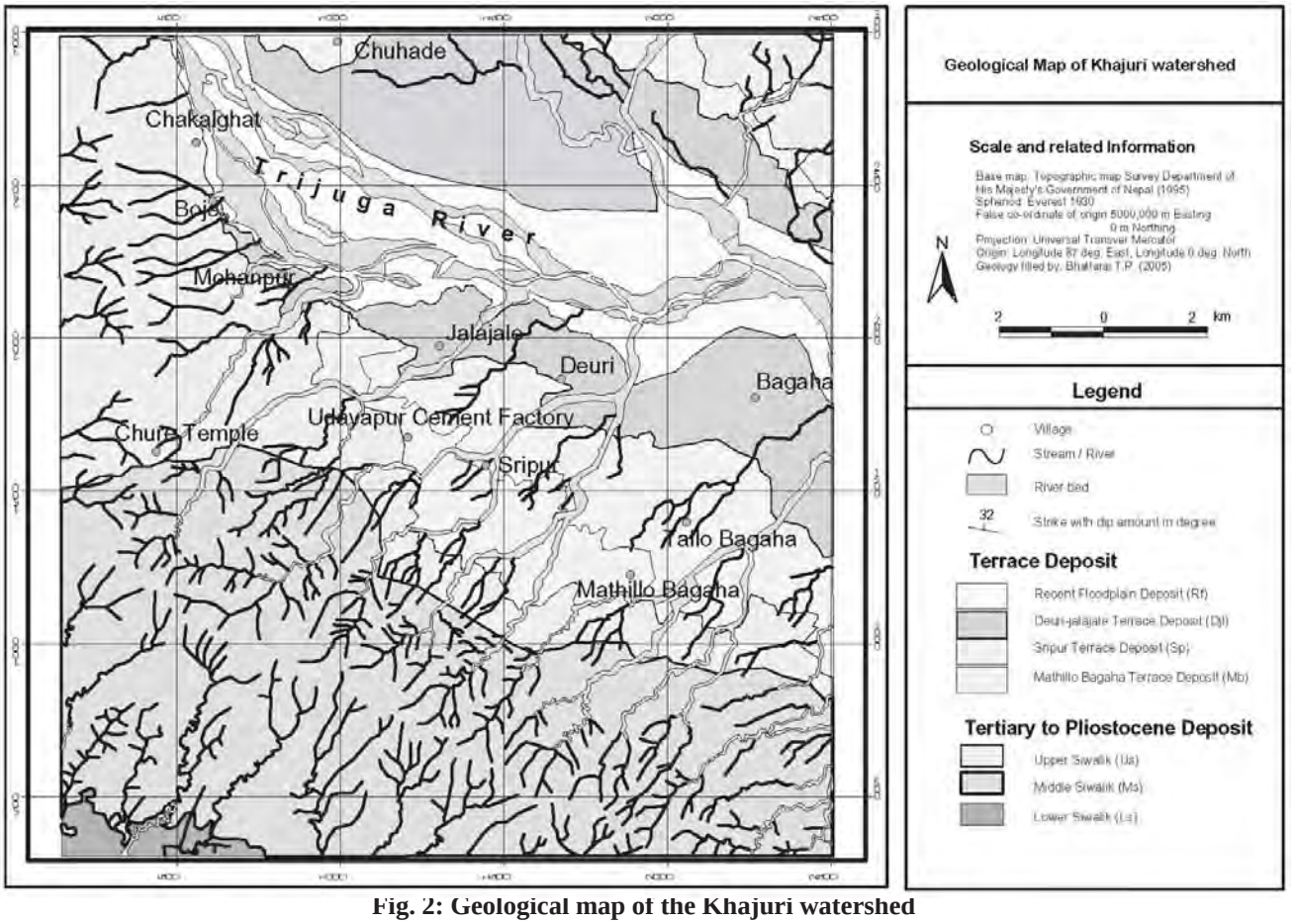

Fig. 2: Geological map of the Khajuri watershed

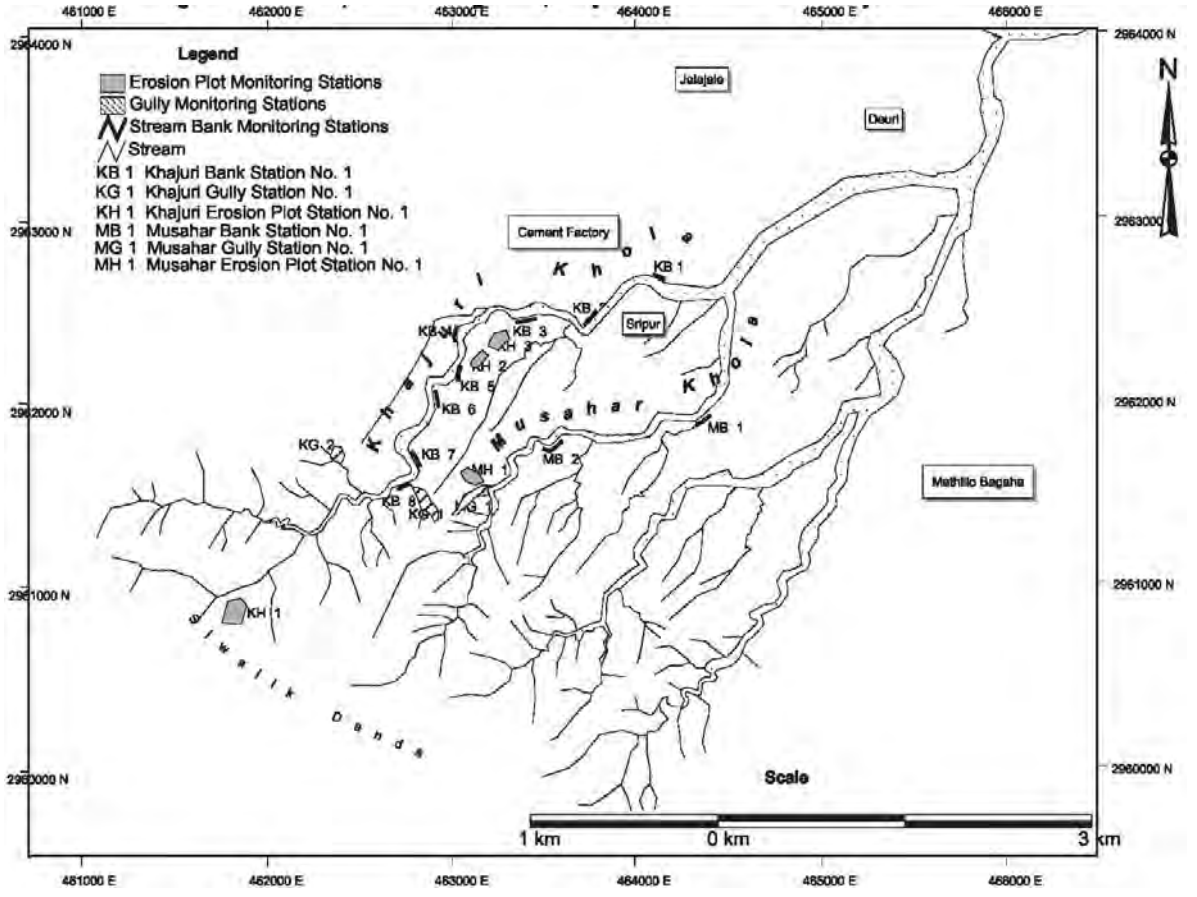

Fig. 3: A map representing location of monitoring sites of gullies, erosion plots and banks in the Khajuri watershed (Gullies: KG1 head, KG2, KG3 and MG1; Erosion plots: KH1, MH1, KH2 and KH3; Stream bank stations: KB1, KB2, MB1, KB3, KB4, MB2, KB5, KB6, KB7 and KB8)

the watershed. Therefore, the sediment yield is always less than the erosion from the watershed. Sediment yield from the watershed is a function of water discharge from the outlet, area of watershed and precipitation in the watershed. Water discharge is a function of watershed area. The gross erosion within the watershed is the sum of all types of erosion as inter rill, rill, gully, channel, and other mass wasting phenomena. The gross erosion from the Khajuri watershed was estimated 41,520 m^3/year (Table 1). The soil erosion from the Khajuri watershed contributed in decreasing order of magnitude were from gully erosion (48.3%), bank erosion (28.1%) and surface erosion (23.6%). Considering the practical value of density of particles, i. e. 2.65 g/cm^3 (Biswas and Mukherjee 1999), the net soil erosion rate of the Khajuri watershed was 92,000 tons/km^2/year.

Table 1: Total sediment yield and their sources in the Khajuri watershed

Type	Source	Parameter	Volume (m
Stream Bank	Khajuri Khola	Length = 4,600 m; Avg. bank height = 3.5 m; Avg. width of erosion = 0.65 m; Erosion from bank = 10,470 m^3	11,650
	Musahar Khola	Length = 3,500 m; Avg. bank height = 2.8 m; Avg. width of erosion = 0.12 m; Erosion from bank = 1,180 m^3	
Gully		No. of gullies = 245; Avg. length of gullies = 45 m; Avg. height of gullies = 6.5 m ; Avg. width of erosion = 0.28 m	20,070
Surface		Area = 4,900,000 m^2; Avg. depth of erosion = 0.0002 m	9,800

Gully, hillslope and bank erosion

Gullies are very common in the farmlands and hillslopes in the Siwalik region. A number of torrent-bank gullies were

developed by head ward retreat in erodible hillslope in the study area. Shaping of gully includes formation of tension cracks at the rim of the head. After this, the sidewalls collapse, and length and width of gully expand. Undercutting at the gully head by plunge-pool activity and fluting simultaneously operate in each remarkable rainfall. Most of the gullies have leaf shape. The head reach of the gully ranged from 5 to 70 m forming vertical cliffs. The length varied from 150 to 200 m. The erosion rate of the monitored gullies was highest in KG1 (0.72 m/year), intermediate in KG3 (0.42 m/year) and least in KG1 head (< 0.01 m/year).

Among the four erosion plots, the rate of erosion at MH1 was measured to be 0.07 m/year, and in other stations it was more or less equal (0.09 to 0.12 m/year).

In the uppermost and the lowermost reaches of the Khajuri Khola, the rate of scouring remained very high (up to 4 m/year), whereas in the middle reach the rate of erosion was low (0.032 m/year). The banks comprised alternate layers of sandstone, mudstone and rarely pebble conglomerate. Selective scouring occurred on the lower portion of the bank where loosely consolidated conglomerates are eroded first resulting in overhang of the bank.

CONCLUSION

Among the three types of erosion observed in the study area, the bank erosion rate (4 m/year) was the highest (in the terrace deposit), gully erosion rate was the intermediate (up to 0.72 m/year), and hillslope erosion rate was the least (up to 0.07 m/year).

The net soil erosion rate of the Khajuri watershed was 92,000 tons/km^2/year. About 22,750 tons of sediment produced per year from the terrace deposits as measured from stream bank stations. Concentrated flow in channel, low elevation of bank and loose sediment were reasons of the huge sediment production. The total erosion rate for the Upper Siwaliks were 13,300 tons/year. The gully development process was not as threatening as in the Middle Siwaliks. The total erosion rate for the Middle Siwaliks, were 53,300 tons/year. The gully development, channel erosion and the rate of erosion were found to be higher in the Middle Siwaliks compared to the other zone.

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Overview of pore-pressure and carbon dioxide in hydrocarbon migration

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ABSTRACT

Organic rich source rocks and carrier beds function like conduits for hydrocarbon migration. Fluid and gas pressure developed in these rocks contributes in hydrocarbon migration. Diffusion through the pores and hydrocarbon movement through pressure-induced micro-fracture is the best-accepted mechanism for the primary migration of hydrocarbon. In case of secondary migration of hydrocarbon, combined effects of porosity, fluid buoyancy, capillary forces and surface tension determine the migration pathways.

INTRODUCTION

In the last couple of decades, many researchers in petroleum industry tried to understand the various aspects of hydrocarbon movement like migration, entrapment, and their control mechanism (Andresen et al. 1994; Rudkiewicz and Behar 1994). In the past, hydrocarbon migration was assumed to be due to pore-water expelled under compaction. According to Hinch (1980), migration of hydrocarbon was essentially independent of water movement. Recently, some researchers have introduced pore pressure-related mechanisms (Jacobson 1991; Selley 1998; Berg and Gangi 1999). Therefore, a brief review on hydrocarbon migration is made.

FUNDAMENTAL OF HYDROCARBON MIGRATION

Pore pressure that is less than hydrostatic pressure, which is commonly a case of non circulating fluid, produces subnormal pressure or an underpressure zone (Selley 1998). If fluid pressure exceeds hydrostatic pressure it creates an overpressure zone (supernormal pressure). The pressure that exceeds the pore pressure tends to develop fractures in rocks and is known as the fracture propagation pressure. If the pore pressure exceeds this fracture gradient zone then hydraulic fracturing occurs. This allows the fluids to escape, conceal the fracture and the pressure to build again (Selley 1998). Permeability barriers control the pressure in the overpressured zone. Dehydration of gypsum and dewatering of compacting clays generate pore pressure in rocks.

Source rocks contain inroganic porosity, which is a fluid porosity plus organic solid in the source rocks (Rudkiewicz and Behar 1994). Compaction of the subsurface sediments decreases the inorganic porosity with depth (Rudkiewicz and Behar 1994). Decrease of volume of organic solids may generate potential pore fluid pressure.

During or prior to the generation of over 96% of oil from source rocks, less than 5% of the gas is formed (Berg and Gangi 1999). However small biogenic and epigenic methane, carbon dioxide, and other heterocompounds (nitrogen, oxygen, sulfur and hydrogen sulfide) produced cause initial changes in pore pressure in the organic rich source rocks (Hunt 1979). High pressure is more readily developed by gas generation than by oil generation because of the much lower density of gas. Theoretically, if the change of volume of these gas phases is large then it exerts a force that develops fracture permeability. Pressure-induced fracture provides a passage to the fluid/gas to expand and migrate through the adjoining rocks (Hunt 1979).

Cracking of organic source rock converts the solid organic compound to droplets of oil. If the droplet diameter is smaller than the pore throat then it experiences the force of buoyancy (England et al. 1991; Selley 1998), and flows, which continues until the pore throat becomes smaller than its own size. Fracture caused by the excess pore pressure during this phase is a mechanism that facilitates further movements of oil droplets. A droplet gets entrapped if it can not overcome the capillary pressure (Selley 1998) due to capillary seal. Similar to this effect, gas entrapment occurs due to pressure seals. Pressure seal occurs if the pressure (buoyancy) in the hydrocarbon column is less than the pressure of the overlying shale (lithostatic pressure). Pressure seals are commonly found where over-pressured clays overlie normal-pressured sands (Selley 1998). Gulf coast is an example of over-pressured basin where pressure seals are encountered.

ROLE OF PORE PRESSURE ON PRIMARY MIGRATION

Many models outline the role of pore pressure on hydrocarbon migration. A model describing migration through fracture is considered the best compared to the migration through displacement pressure. Moreover, Hunt (1979) emphasized on diffusive migration of hydrocarbon in the early stage of hydrocarbon generation.

Migration of fluids out of the source rocks during the primary migration involves fluid generation and mass transfer (Rudkiewicz et al. 1993). Energy enabling the primary migration is either the pressure changes in the source rock during thermal cracking or pressure-induced microfacture (Berg and Gangi 1999). Excess pore-fluid pressure in the source rocks is built up during the transformation of high-density kerogen in to low-density hydrocarbon (oil or gas). Pore fluid pressure generated by compaction of shale builds up pore pressure equal to the lithostatic pressure. Moreover, pressure developed during the fluid transformation dissipates rapidly in high permeability source rocks whereas in low permeability rocks the pore pressure develops fracture due to accumulation of pressure (Berg and Gangi 1999).

ROLE OF PORE PRESSURE ON SECONDARY MIGRATION

Secondary migration of hydrocarbon involves movements essentially from the source rocks to the reservoir or traps. Pressure change due to oil generation results significant change in the preexisting buoyancy, capillary forces, and subsurface hydrodynamic condition (England et al. 1991). Hydrodynamics significantly changes the capillary resistance of the carrier beds and controls the migration pathways (Khan et al. 2006). Oil expulsed from the source rocks as droplet travels along porous media and migration continues until the hydrocarbon is trapped in the reservoir rocks (Selley 1998).

ROLE OF CARBON DIOXIDE ON HYDROCARBON MIGRATION

Carbon dioxide is important component in hydrocarbon migration (Hunt 1979). Origin of carbon dioxide responsible for primary migration is microbial, i. e., thermal and microbial decarboxylation of organic acids, and dissolution of carbonates (Rudkiewicz et al. 1993; Andresen et al. 1994). CO_2, responsible for secondary migration, originates from dissolution of carbonate minerals, and deep crust (Andresen et al. 1994). CO_2 generation reduces pore volume in the source and the reservoir rocks. Reduction in the source rock pore volume results in decrease of permeability, highly increasing the formation-pressure. Localized pressure built-up this way produces the micro-fracture and leads to expulsion of hydrocarbon from the source rock (Hunt 1979). CO_2 are mostly produced at the early stage of diagenesis, and the mobility of oil increases with the increase of CO_2. Presence of CO_2 greatly increases the mobility of the lighter hydrocarbon.

CONCLUSION

Hydrocarbon migrates from organic rich source rocks to reservoirs or traps through different modes. Diffusion of fluid is one of important processes. Fluid and gaseous compounds and oil exerts pore pressure. Thermal cracking of kerogen produces pressure that expels hydrocarbon. Whether it is mechanical expulsion of oil or migration through fracture, migration of oil is made possible by pressure derived mechanical force. Fluid pressure developed from fluid movement is another cause that drives the hydrocarbon. Moreover, buoyancy, capillary force and pressure of coarse-grained reservoir rocks are driving mechanisms in secondary migration.

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Overview of climatic change during Holocene

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ABSTRACT

Researchers have used the records from the Greenland Ice Sheet core, equatorial Eastern Africa, North Pole, South Pole and Tropical Regions to obtain the Holocene climate. Most of the low, mid and high latitude regions were cold and dry during Early-Mid Holocene (8.2 ka BP). The wet climate prevailed in Early-Mid Holocene. The intervals oil 11-9.5 ka BP and 8-7 ka BP has been reported major dry climatic events. The Little Ice Age (1500—1800 AD) was another climatic oscillation, which showed cold climate during Late Holocene. Before LIA around 900-1300 AD, climate was interpreted to be warmer than at present.

INTRODUCTION

Holocene climate can be identified relying on long- and short-term climatic changes. Ice sheets, ice caps, glacier, oxygen isotope, tree ring and pollen have been the proxy sources from which the Holocene climates have been interpreted. Recently, many marine and terrestrial paleoclimate data have been obtained from the ice core, North Atlantic region, and from the low and the high latitude regions (Meese et al. 1994). Abrupt climate optimum after the Last Glacier Maximum, Little Ice Age (LIA), and 20th century warming are some of the events, which have created controversy among the scientists. During the Holocene period, continental and mountain glaciers covered earth's surface. According to Alley et al. (1997), global cooling took place around 8.3 ka BP. LIA showed cooler climate condition during the Late Holocene. Moreover two ice cores from the Tibetan Plateau and the Tropical Andes (South America) strongly indicated the 20th century warming.

PALEOCLIMATIC RESEMBLANCE AMONG DIFFERENT LATITUDES

The major reorganization of Holocene climate 8.2-8.4 ka BP has recently been documented based on the paleoclimate records from Greenland Ice Sheet cores (GISP2) of the Northern Hemisphere (Alley et al. 1977), and from African lake sediment and Antarctica ice cores (Stager et al 1997). Stager et al. (1977) suggested that the climatic change between 8.4 and 8.2 ka BP was similar in equatorial Eastern Africa (Northern Lake Victoria), Antarctica (Taylor Dome), and Greenland, between 8.4 and 8.2 La BK. The diatom proxy from the Lake Victoria introduced that the increased Na^+ concentration was synchronous with decrease of precipitation/ evaporation ratio or level of the lake or wind driven mixing in the lake.

DeMenocal et al. (2000) reported the climatic linkage between subtropical Atlantic and sub polar Atlantic regions. The millennial-scale cooling in the former reoccurred in every 1.5 ± 0.5 ka, whereas in the latter in every 1.47±0.5 ka duration. Both indicated the maximum aridity cooling to about 8.0 ka BP. Isotopic record ($d^{18}O$) from the Arabian Sea showed the prominent cooling events at 11.66 and 4.5 ka BP, which were similar with events of high latitude Northern Hemishpere (Greenland lee Sheet). The paleo climate link between subtropical Santa Barbara Basin (East Pacific) and Lake Barombi Mbo (West Cameroon, tropical Africa) exhibited similarities since the last 25 ka (Heusser and Sirocko 1997). The greater number of *pinus* pollen was reported to be older than 10 ka BP. The *grarminae* pollen was reported to be greatly deminished between 9 and 4 ka BP suggesting predominance of tropical rainforest. Remarkably, the pollen showed the same reoccurrence period (1.45 and 1.1 ka) which was similar to the periodicity of the Greenland Ice Sheet core (Grootes and Stuver I 993).

CLIMATE OVER LAST MILLENNIUM

The Ice cups used for climatic variation were Northern Hemisphere (Greenland, Camp Century), central Asia (Dunde, Guliya and Greorieve), South America (tropical Quelccaya ice cap in Peru), and Antarctica (Siple station and South Pole core) (Alley et al. 1997; Kreutz et al. 1997; Mann

et al. 1999; Thompson 2000). There were some common features among the ice records.

(1) Isotope records of two Northern Hemisphere sites were similar. The results from Siple station and South Pole exhibited that the climate in the low-latitude should have been colder during the LIA and warmer during the 20th century.

(2) Isotope records of the Quelccaya ice cap in Peru and South Pole Antarctica were also similar including LIA (1530-1900 AD). Thompson (2000) documented the warming and retreat of the Qulccaya ice cap.

(3) Chemical records from the new ice core at Siple Dome, West Antarctica, exhibited initiation of LIA at 1372 AD, whereas the Greenland Ice Sheet experience LIA at 1400 AD (Kreutz et al. 1997).

Mann et al. (1999) suggested that the abrupt warming during 20th century followed the gradual cooling in the Northern Hemisphere for about 980 years. It was reported (from the last millennium data) that nearly 1 ^{o}C temperature was raised during the 20th century.

CONCLUSION

The records of past climatic variation from wide geographic coverage are necessary for modelling current and future climatic trends, and understanding influence of human activities on Holocene climate. Proxy data from different proxy sources indicated that some global and regional climatic trends were similar with each other during Holocene. The event at 8.2 ka was a sudden cooling event, as observed from Greenland Ice Sheet core, giving widespread cool and dry condition, which lasted for 200 years before a rapid return to warmer and moist climate. Most of the low, mid and high latitude regions were dry. North Africa and Central Asia indicated the wet climate during Early-Mid Holocene. Major dry climates were recorded at the intervals of 11-9.5 ka BP and 8-7 ka BP. LIA showed cooler climatic condition during the Late Holocene. Before LIA, around 900-1300 AD, climate was warmer than at present.

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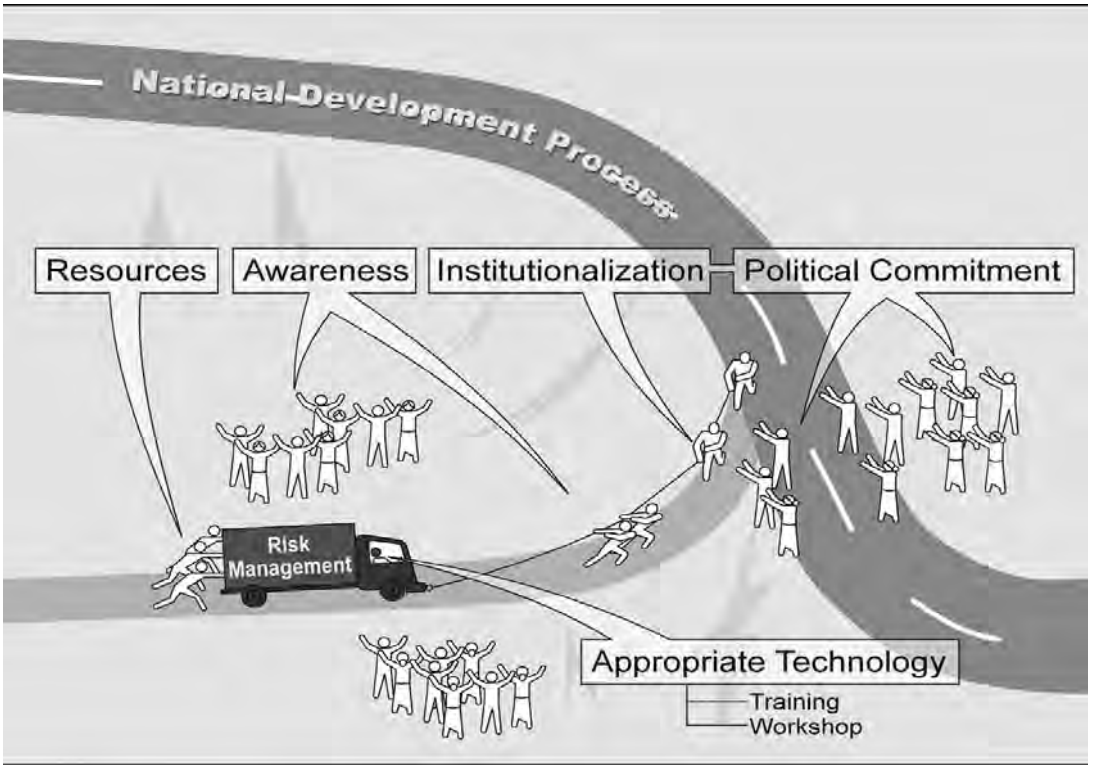

Reducing Earthquake Risk means:

1. **Improving emergency response planning and capability.**
2. **Improving awareness of issues relating to earthquake risk.**
3. **Integrating seismic resistance into the process of new construction.**
4. **Improving the earthquake safety of school children and school buildings.**
5. **Improving the seismic performance of existing buildings.**
6. **Improving the seismic performance of utility and transportation systems.**
7. **Increasing experts' knowledge of the earthquake phenomenon, vulnerability, consequences and mitigation techniques.**
8. **Preparing for long-term community recovery following damaging earthquakes.**

NSET aims to assist all communities in Nepal to become safer against earthquake by 2020 AD by developing and implementing organized approaches to managing earthquake risk.

We understand that this challenge can be achieved only through partnership between communities and institutions.

NSET

National Society for Earthquake Technology – Nepal (NSET)

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